THE OTHER BATTLE

Being a history of the Birmingham Small Arms Co Ltd, with special reference to the war achievements of B S A Guns Ltd B S A Cycles Ltd, and the other subsidiary companies directly administered from the head office of the parent company at Small Heath Birmingham

By

DONOVAN M WARD

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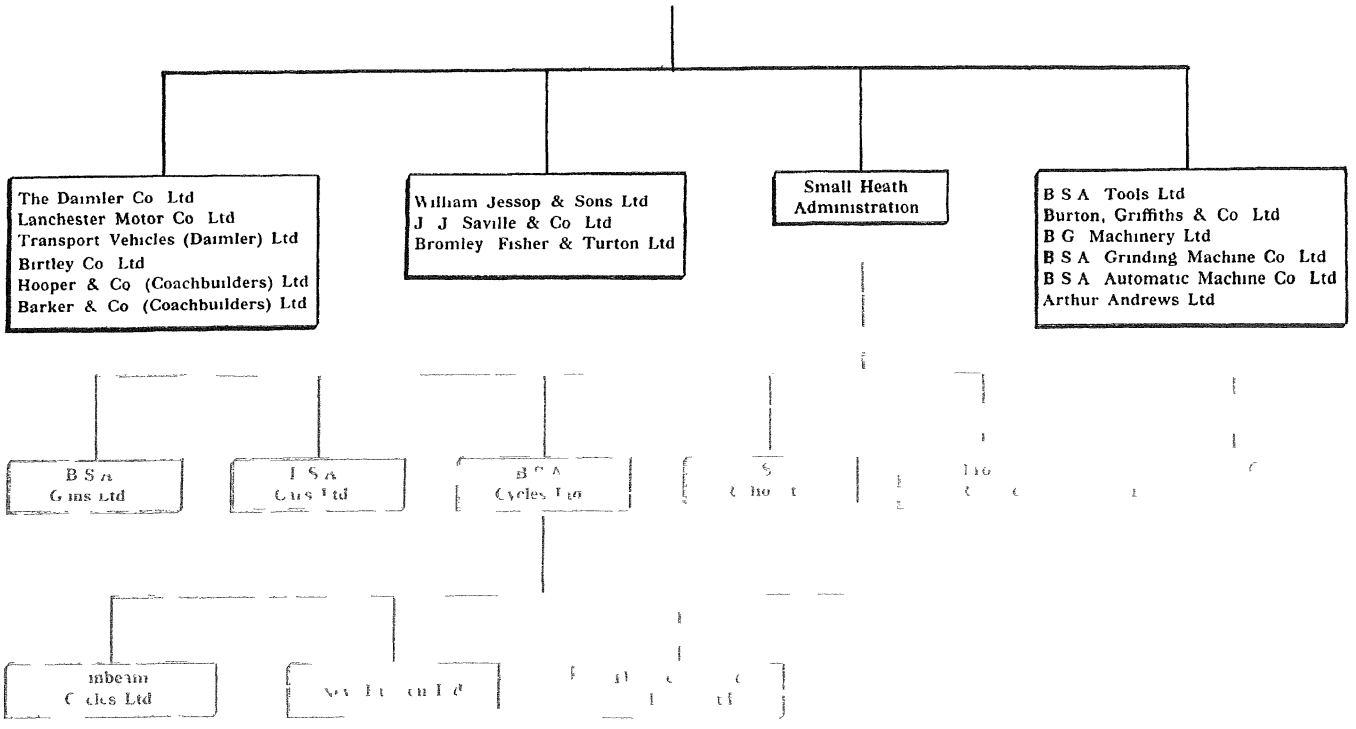


This company 'tree' shows the present structure of the B S A group those in red being directly administered and managed from Small Heath

PREFACE

SHADOW OF LEIPZIG

TO the barked *Links . . . Links . . . Links . . . Links* of their *Oberschscharenfuhrer* there swung into the centre aisle of the great Leipzig Fair in 1935 a squad of the new, black-uniformed S S. troops. The crowd parted as if an invisible snowplough were clearing a way for the goose-stepping automatons. The incident brought home more sharply than any perfervid oration of Adolf Hitler's the significance of National Socialism; it was a renaissance of the German military ideal. Hitler had been in absolute control of Germany's destiny for less than a year, but already the sparks of revenge were being fanned throughout the Fatherland, especially among the youth—revenge for 1918, revenge for Versailles, revenge for the loss of colonies; above all, revenge on Britain.

There was no attempt to hide the prevailing sentiment, although at the Fair, with thousands of foreigners present, a leaven of diplomacy might have been expected. Even the demonstrators who were displaying to the world the latest products of German inventive skill made no secret of their humour. One such demonstrator—he was showing a bullet-making machine capable of the then astonishing output of more than 600 an hour—boasted openly that the bullets were "for England". There was a ripple of laughter from the Germans in his audience but not from the foreigners, among whom were two executives of the Birmingham Small Arms Company. The remark caused them no surprise—they had heard a host of similarly revealing observations during their brief stay in Germany—but perhaps it finally convinced them that, despite all the assurances of politicians at home and abroad, the nations would inevitably be plunged

sooner or later into another world conflict. Already Germany had shown a glimpse of her hand by withdrawing from the Disarmament Conference and from the League of Nations. And now she was equipping an enormous army, building an air force, and laying down submarines in her naval yards—all in defiance of the terms of the Treaty of Versailles.

On returning to England the two executives, the senior of whom was James Leek, who was to become Managing Director of B.S.A. Guns Ltd. and the key man in the company's vast programme of war production, presented the directors with a momentous report. It proposed that immediate steps be taken to reorganize the company's plant and factory space in preparation for armament manufacture. Despite the lean years through which the company had passed and despite the absence of financial support from the Government, which was still actively espousing the cause of international disarmament, the board took the courageous step of sanctioning the heavy expenditure the report involved.

Thus in an hour at Leipzig was born the war effort of the Birmingham Small Arms Company, the products of which were to play a paramount part in the defence of the Empire, in the defeat of the Luftwaffe in the Battle of Britain, and in the final overthrow of the Axis.

* * *

From the time the first order was received under the Government rearmament programme to the day when Japan surrendered, more than 5,000,000,000 components for munitions of war were manufactured in factories under the Small Heath management.*

Although its armaments output ranged over a wide field from shell and bomb fuses to gun carriages it was, appropriately enough, small arms which furnished the company's chief contribution to victory. Indeed, of all precision

* See company tree opposite page 5.

weapons up to a calibre of 20 millimetres manufactured in Britain during the war, no less than some 50 per cent were produced in B.S.A. factories. (This proportion does not take into account the Sten sub-machine gun, which was devised and introduced in the emergency conditions of war). And just as in the Great War the company's name became inseparably linked with that of the Lewis machine gun, so in the World War it became linked with one gun above all the others it made—the Battle of Britain .303 Browning, which, perfected by B.S.A. and Government technicians, was acknowledged at the time to be the finest aircraft machine-gun of its calibre in existence.

* * *

The purpose of this volume is to place on record objectively the story of the Birmingham Small Arms Company and especially the story of the achievements of its 28,000 workers in the war against the Axis. The question of whether a private arms industry should continue to exist in this country is not raised; in fact, it becomes a question of the past, since the harnessing of atomic energy to the chariot of war has altered the whole conception of military strategy.

As a matter of record, however, it should be pointed out that the character of the private arms industry in this country has changed completely in the last 50 years. By the late '90's many foreign countries, which had formerly bought British guns, had begun to establish their own armament industries, with the natural result that orders from abroad steadily dwindled. British arms companies switched to other forms of engineering production—merchant shipping, cars, motor cycles, cycles, light and heavy electrical equipment; in fact, almost everything requiring the precision methods of gun manufacture. Thus it came about that only in time of war could the firms forming the industry be termed "arms companies" with any degree of accuracy.

Even the most ardent advocate of the total abolition of the private arms industry will agree that while this country continued to rely on private manufacturers in times of crisis for its main supply of munitions it was in the national interests that the industry should be maintained in as efficient a state as possible. (It will be seen in the pages of this book that the nation would have indeed been in a sorry plight on many occasions had it not been for the private arms manufacturers).

In this connection the phrase "absence of financial support from the Government" merits a parenthesis. Britain's unpreparedness for a military as opposed to a naval war, as conspicuous in 1939 as it was in 1914, was not a condition peculiar to those years but one tolerated by successive Governments for almost the past 100 years. The small arms industry was alternatively starved and flooded with orders according to the current aspect of international affairs. In every crisis it was suddenly called upon to come to the nation's aid with large deliveries regardless of the fact that a period of peace and consequent absence of British Government orders might have caused companies virtually to close the arms sections of their factories and to transfer all but a nucleus of their craftsmen to other work.

It cannot be denied that in the past expenditure on Britain's defences in periods of peace has been brought too frequently into the sphere of party politics with the result that, to gain temporary popularity or to avoid misguided criticism, Service Estimates have often been reduced to a point far below safety level. However, there are now reasonable grounds for hoping that the days when narrow political considerations can influence defence expenditure are gone for ever. The plans for a world security organization and, even more important, the discovery of means of releasing atomic energy, have lifted the question of relations between individual countries from national to international level.

CHAPTER I

THE GROWTH OF AN INDUSTRY

BIRMINGHAM has for centuries been the centre of the country's small arms trade. There was certainly an established trade in the city by the early 16th century, for in 1538, for instance, John Leland, a churchman, travelling through the Midlands, wrote:—

> *"I came through a praty street or ever I entered Bermingham This street, as I remember, is called Dirty (Deritend) In it dwells smiths and cutlers and there is a brooke that divides this street from Bermingham . . . There be many smiths in the towne, that use to make knives and all manner of cutting tools, and many lorimers that make bittes, and a great many naylours, so that a great part of the toune is maintained by smiths, who have their iron and sea-coal out of Staffordshire"*

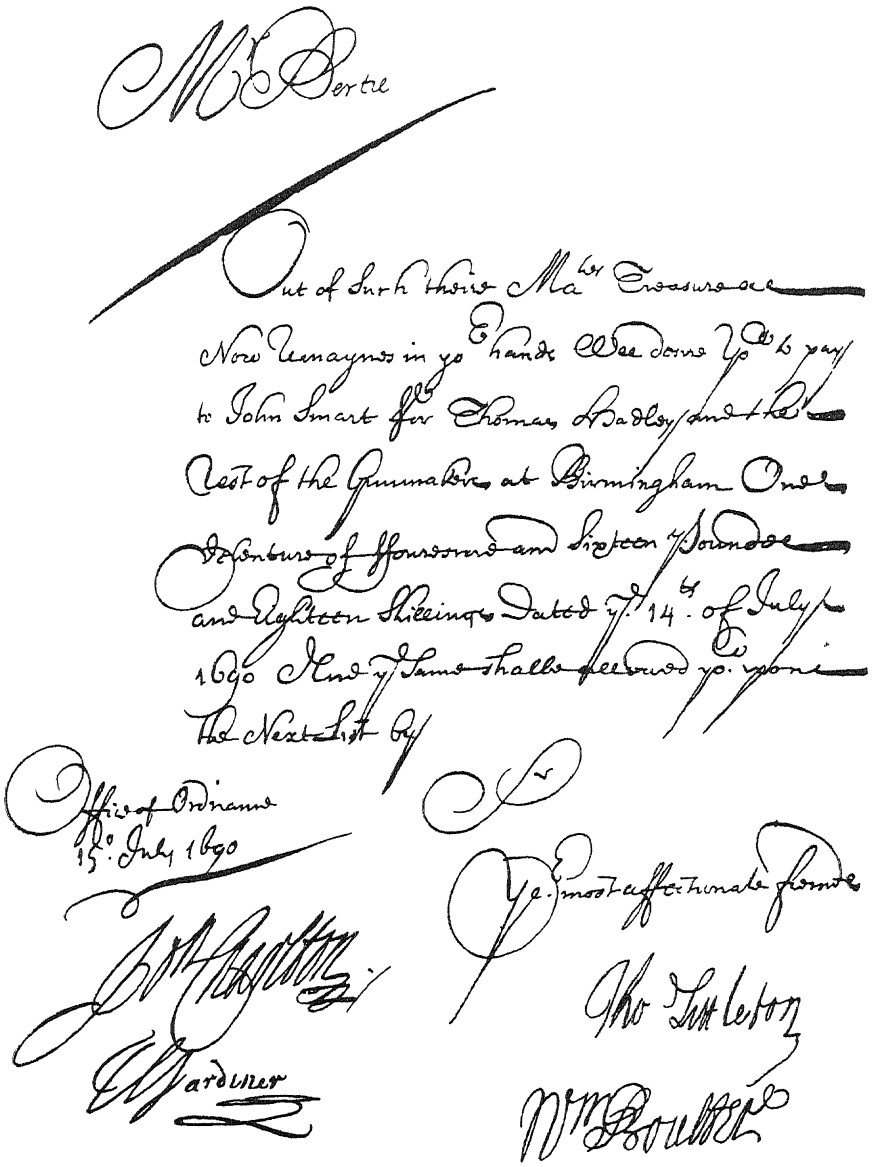
But these craftsmen, skilled as they might be, were far from being able to satisfy their country's military needs, and Henry VIII had to import Italians to teach the art of making bronze cannon, Dutchmen to make shells and bombs, and Flemings to make armour and swords. It was not only in arms that England lagged. Virtually all gunpowder was imported from Antwerp until the lesson of the Armada in 1588 when Howard of Effingham and Drake were prevented from destroying Philip's fleet off Plymouth before it sailed up the Channel by a desperate shortage of powder which forced them to break off action after their preliminary victory.

By the time of the Civil War the manufacture of arms had become an established trade in Birmingham. Indeed, the industry was so important that in April, 1643, Prince Rupert sacked and burned part of the town to stop its flow of weapons to the Parliamentary forces, whose cause it favoured.

It was towards the end of the 17th century that there occurred the most important development in the city's history of arms manufacture. Although the fame of Birmingham swords had already spread abroad—a traveller visiting Milan and noting the "fine works of steel there" observed that "they could be had better and cheaper in Birmingham" —it had not apparently reached London, and the British Army was still equipped with Dutch weapons. The King, William III, expressed concern that guns and swords were not made in his dominions and had, therefore, to be procured from Holland "at great expense and greater difficulty". Among those who heard the King's complaint was Sir Richard Newdegate, one of the Members of Parliament for Warwickshire, who pleaded the cause of his constituents. "Much genius", he assured the King, "resides in Warwickshire", and Birmingham smiths were "well able to answer the royal wishes". A trial order from the Crown in 1689 was satisfactorily executed; subsequently "Their Majesty's Board of Ordnance" entered into a contract with five leading gunsmiths of Birmingham, who, on behalf of themselves and their fellow master craftsmen, undertook to supply 200 Snaphance muskets every month "at seventeen shillings per piece ready money".

This system of group contracting by the Birmingham trade continued for 150 years, during which time enormous quantities of firearms were supplied not only to the British Government but also to foreign armies; in fact, in the period of war which ended with Waterloo it is estimated that the 7,000 people employed in the city were producing weapons at the rate of 525,000 a year.

Although after the Napoleonic Wars Government orders naturally declined, Birmingham still manufactured immense numbers of complete weapons in addition to supplying barrels and locks to gunmakers in all parts of the country.



◆ *This document, now in the possession of the Birmingham Proof House, is an order to pay the Birmingham gunmakers for the supply of arms to the Crown.*

By far the largest numbers of the finished guns, weapons of the cheapest variety, were bought by London and Liverpool merchants, who bartered them with African natives for ivory, spices and gold.

Another arms boom followed the French Revolution of 1848, orders flowing in from Sardinia, Sicily and Denmark, and not only did the Birmingham makers fulfil big contracts for new weapons but, what was more, they were able to dispose of large quantities of old stock at enhanced prices.

It was at this period that a new factor commenced to make its influence felt in the industry—the machine. Although Birmingham supplied 156,000 rifles for the British forces in the Crimea between December, 1854, and April, 1856, against 75,000 obtained by the War Department from all other sources at home and abroad in the same period, it began to feel towards the end of the war the competition of the Government factory at Enfield, which had been established at the beginning of the century.

In the summer of 1855 Enfield had started to produce weapons by machinery, and by the time peace was declared in April, 1856, it had attained output of more than 2,000 rifles and carbines a week; thenceforward its activities had a progressively adverse effect on the trade of Birmingham. The city's gunsmiths continued to preach the gospel of the hand-made weapon, but inevitably it was a losing struggle. Orders dwindled to such an extent that they were forced to a decision; they must either buy machinery or go out of business. Finally, at a meeting of members of the Birmingham Small Arms Trade in June, 1861, it was resolved to form a company, "The Birmingham Small Arms Company", to manufacture guns by machinery.

CHAPTER II

FIGHT FOR ORDERS

WITH an initial capital of £24,500, the first step of the Birmingham Small Arms Company was to buy its present chief site at Small Heath—25 acres at £300 an acre—and to build thereon a factory at a cost of £17,050. To link the new works with Golden Hillock Lane, the main thoroughfare in the neighbourhood, a road was constructed on the company's land. It was named Armoury Road and along it down the years millions of guns were to pass to the battlefields of the world.

During the first two years of its existence the company's affairs were administered by a committee consisting of all its shareholders. Not very surprisingly it proved a clumsy form of control and at an extraordinary general meeting held on September 30, 1863, there was elected a board consisting of Mr. J. D. Goodman, Chairman; Mr. J. F. Swinburn, Vice-Chairman; Mr. Joseph Wilson, Mr. Samuel Buckley, Mr. Isaac Hollis, Mr. Charles Playfair, Mr. Charles Pryse, Sir John Ratcliff and Mr. Edward Gem.

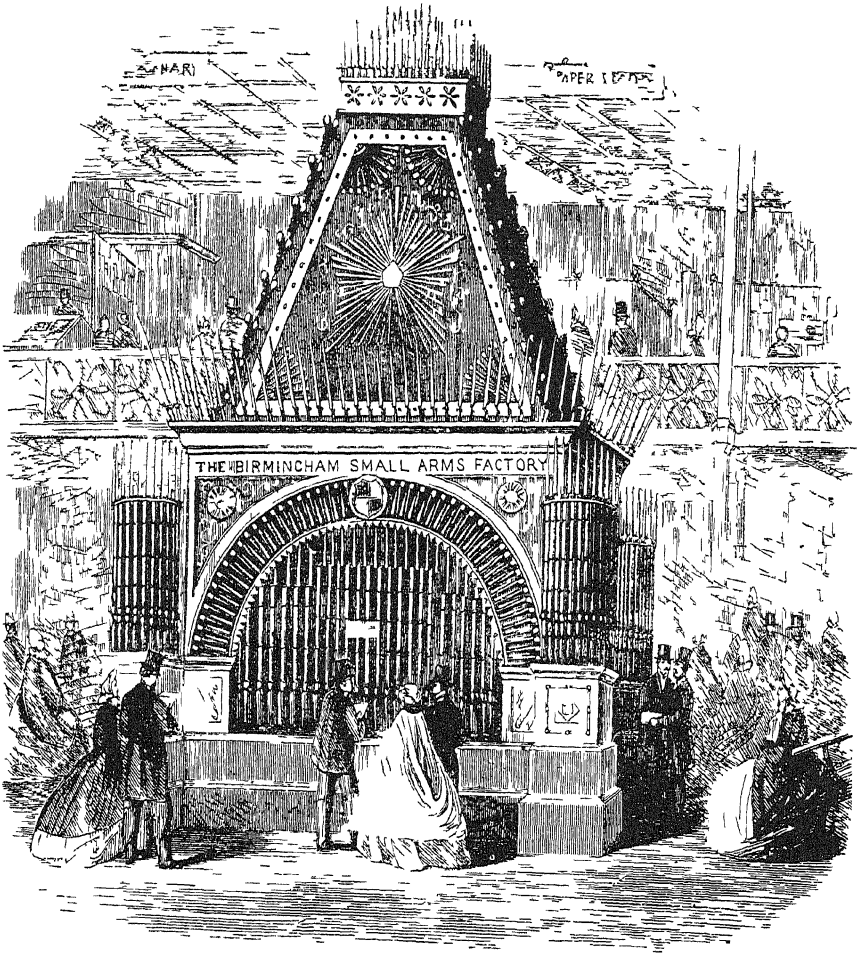
By the end of the year preliminary work was begun on the company's first big order—20,000 Enfield rifles for the Turkish Government. This was part of a contract for 50,000 placed with the Birmingham trade and was secured through the good offices of Mr. Goodman.

Mr. Goodman, who remained chairman until his death in 1900 at the age of 83, might well be described as the company's guardian angel. Certainly but for his enterprise and his unceasing battle on behalf of the company (and of the private arms trade in general) it is doubtful whether

B.S.A. would have survived some of the crises through which it passed in the latter part of the 19th Century. When rifle contracts for the British Army failed to materialize he did not hesitate to take the matter to Cabinet level and, on one occasion, to the then Prime Minister, Lord Palmerston.

With the passing of the years the company, directors and workers alike, indeed the whole of the Birmingham gun trade, came to feel, with some justice, that, except in times of national crisis, they were doomed to be the unwilling sacrifice on the altar of Enfield, which remained the principal Government source of small arms.

It was in the summer of 1866, just five years after its formation, the company received its first British Government contract. It was not for new rifles but for the conversion within 20 months of 100,000 muzzle-loaders into breech-loading weapons on the principle evolved by Snider, a Dutch-American wine merchant. It was a valuable order, being worth £98,750, but like so many in the future it was only inspired by alarm. The Cabinet, suddenly fearful lest Britain become involved in the Austro-Prussian war, decided that the whole army must be equipped with breech-loading weapons. So urgent was the demand for these conversions that for the first time a night shift was instituted at Small Heath and an output of more than 3,000 conversions a week was eventually attained. The first batch of 50,000 was completed in 10 months, the last being delivered for Government inspection a quarter of an hour before the contract time expired. The achievement was regarded at the War Office as a miracle. But it was a miracle that B.S.A. and its workmen were to repeat again and again in years to come in times of international crisis. To mark the occasion the directors presented the three foremen chiefly responsible for executing the contract with a special bonus of £100 each,



◆ *The display of the Birmingham gun makers at the International Exhibition of 1862.*

an action at that time without parallel in the industry. The whole order for 100,000 conversions was finally completed in February, 1868, seven weeks before the day named in the contract.

With large contracts from foreign countries B.S.A. was by this time the largest private arms company in Europe and Small Heath was working to capacity.

Nor was research being neglected, for the company was continually experimenting on the improvement of rifles. In 1865 a B.S.A.-built Whitworth weapon had won an open contest for a small-bore breech-loading rifle; while in the following year a B.S.A. muzzle-loading rifle had triumphed in the Queen's prize at the National Rifle Association meeting, then held at Wimbledon.

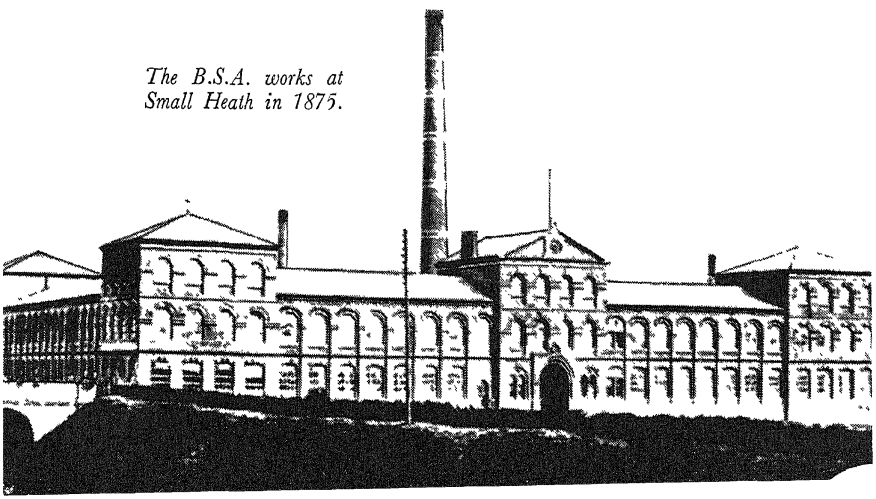
The outbreak of the Franco-Prussian war found the Government nervous of being involved and unprepared for a major campaign. In consequence B.S.A. was asked as a matter of extreme urgency to state the number of Snider rifles it could turn out by the end of the following March. The company, however, was in a difficult position. With no Government work on hand or likely, almost all the machinery had been adapted to fulfil a Russian contract for rifles. Work on this order had not begun because of last minute alterations to the design. The company had, therefore, been unable either to take up fresh work—it could have obtained enormous orders from the belligerents—or to proceed with the contract in hand. But whatever treatment it had received in the past from Whitehall, it recognized the supply of new rifles to the British Army as the national emergency it indeed was and again stepped into the breach.

The War Office received a reply that B.S.A. could supply 20,000 in the stipulated period and a further 48,000 in the following year. Within two weeks all the machinery at Small Heath had been readapted and work on the 20,000 rifles was in full swing with a double shift operating. Expenditure on preparations for the Russian order—some £30,000 without any return as yet—had left B.S.A. short of money but this position was eased by the sale, chiefly to France, of surplus stocks of all weapons not required by Britain. Another problem was labour. Numbers of skilled men, who had been dismissed earlier in the year, had to be found and

re-engaged or else replaced; no easy matter when craftsmen were in great demand. However, all difficulties were overcome and the weapons duly delivered to time. The War Office at once intimated that the company could expect contracts for the 48,000 rifles it had stated it could make in the next 12 months, but with the collapse of France and the signing of peace in May, 1871, the crisis was over and the orders did not materialize.

In the summer of the same year it was finally decided to equip the British Army with a new rifle, the Martini-Henry, joint product of Frederick von Martini, a German lace manufacturer, and of Alexander Henry, a Scot, who invented a new form of barrel rifling. The company was asked to start manufacturing the necessary tools and gauges. In the following February it was informed that, in view of the switch to a new weapon, there would be no further orders for Sniders, but that, as compensation, an extra payment of five shillings each would be paid on the last contract for 20,000 rifles. It was profit, but it was by no means the same thing as work which would have kept the factory on full time and its employees together.

An incident at this period of the company's history might well have formed the plot of a "thriller". It became known



The B.S.A. works at Small Heath in 1875.

that Turkey was to buy 200,000 rifles and that the order would be placed after a trial of various types of weapons. A vast sum was involved and armament firms in all parts of Europe and America sent representatives to Constantinople. B.S.A. dispatched two officials from London but the rifle which they were to enter in the trial and which had been sent to the company's agent to forward, failed to arrive in time and the order went elsewhere. Later it was discovered that the company's agent was also acting for two firms in the United States and had deliberately held back B.S.A.'s entry in the hope that the order would go to one of the American companies, from which a larger commission could be expected.

An order from the Prussian Government for 40,000,000 cartridge cases caused an internal reorganization at Small Heath in 1873. The old company went into voluntary liquidation, its assets being sold to a new company, "The Birmingham Small Arms and Metal Company", and by this title it continued to be known for 24 years until 1897, when the ammunition business, which had been centred at an Adderley Park factory, was sold to the rapidly expanding Nobel interests (forerunner of Imperial Chemical Industries) and the company reverted to its original title.

CHAPTER III

A NEW VENTURE

THE three years from 1878 to 1880 were momentous in the company's history. Early in 1878 the company heard there would be no Government orders for the next financial year. This was bad enough but worse was to follow for in the April of the same year the Government auctioned 100,000 firearms at Weedon. Foreign buyers, who would otherwise have bought new arms, attended in force and all the weapons were sold in a few minutes. It was an incredible time for such a sale since at any moment Britain might have become involved in the dispute between Russia and Turkey. It is true that the rifles were described as obsolete, but they were perfectly serviceable and no more out of date than many of those issued to the Turkish and Russian troops. All that the Treasury gained by the sale was some £15,000. There was an immediate public outcry, which resulted in the banning of such sales. Thereafter obsolete arms had to be destroyed and used as scrap.

The repercussion of the auction was felt immediately. In the same month, April 1878, half time was ordered at Small Heath, and on August 19 the entire plant was shut down. This was a bitter blow, although it was to prove a blessing in disguise for the directors, finally realizing the precarious nature of Whitehall patronage, turned their attention to other fields of engineering.

Although it was a War Office order for 6,000 rifles which caused Small Heath to reopen in August, 1879, after being closed for exactly a year, the directors were investigating

the question of cycle manufacture for which the Small Heath plant was admirably suited.

Early in 1880, the year in which the company adopted as its sign the "Piled Arms", which was later to become its trade mark, a Mr. E. Otto was invited to a board meeting to demonstrate a new cycle he had invented—a machine with a wheel on either side of the rider. Mr. Otto's idea of a demonstration was to ride his machine up and down the big table at which the directors were seated. At the end of the demonstration he re-mounted his machine in the Board Room and rode down the stairs and out into the roadway, disappearing in the direction of Birmingham at what one of the more elderly directors described as a "reckless pace".

After long conferences the directors finally reached a decision which was to influence the whole future of the company: B.S.A. would enter the cycle industry by manufacturing 200 of the new Otto cycles. Soon Small Heath was making cycles and tricycles not only for other firms but also to its own designs.

Cycle manufacture remained ancillary, however, to small arms production and the company played a large part in re-equipping the British army when, in 1888, the War Office decided to adopt the Lee-Metford as its new weapon. This rifle replaced the Martini-Henry, in which the Egyptian campaign of 1884-1885 had revealed serious defects.

B.S.A. received instructions to produce 1,200 a week and a specimen gun was sent to Small Heath to enable the company's technicians with their intimate knowledge of rifles to make a thorough examination and offer their criticisms before manufacture began. But the War Office's idea of a thorough examination was somewhat peculiar for ammunition to try the gun on the range was refused "as a test of such a nature was not necessary". One glaring defect

was formally reported, but it was not until several years later, after a vast number of rifles had been issued to the troops, that the fault was officially "discovered".

As a result of the Lee-Metford order the directors decided to abandon cycle manufacture. It was a decision taken only with the utmost regret since it meant sacrificing the great reputation the company had built up in the cycling world for the quality of its products. There was, however, no practical alternative: the Army must come first.

The break with the cycle industry lasted only five years, for in November, 1893, the directors re-entered the field, not this time with a complete cycle but with components, for which there was an enormous demand.

Soon the whole of the company's shell-making plant had been converted for cycle component production. Women were taken on for the first time and a double shift put into operation. Orders continued to pour in; within 18 months their value had doubled, trebled, and quadrupled, until by May, 1895, they had reached a total of £4,620 a week. To cope with this increase of business new buildings were constantly being erected.

In addition to cycle manufacture, the directors had been following with the keenest interest the development of the motor car, and in April, 1899, a contract was accepted for the manufacture of a batch of internal combustion engines. But once again a B.S.A. venture into a new field was to be interrupted by urgent Government orders.

CHAPTER IV

THE BOER WAR

AFTER an order for 40,000 rifles in 1896, there had been a steady decline in British Government contracts, but with the cycle side of the business flourishing this was no longer, from the financial point of view, the serious matter it would have been in the company's earlier days. From the national viewpoint, however, the directors could not view the position with the same equanimity and as the situation in South Africa deteriorated they informed the War Office that in the event of sudden large orders it would be at least six weeks before output could be increased above 300 a week. At the same time, as a precaution, they ordered for immediate delivery enough steel for the manufacture of 20,000 weapons.

The directors' fears were justified, for five weeks after notifying Whitehall of the output position there was delivered at Small Heath—on February 6, 1900—a telegram from the War Office which read: "Please take all necessary steps to work up to your largest rate of production of rifles by the earliest possible date." The telegram was followed by a contract for 41,360 rifles.

On the heels of this order came another for immediate fulfilment—new sight leafs for Lee-Enfields, which were in the hands of troops in South Africa and which had been found to be incorrectly sighted. The existence of this defect had been known in the trade for a matter of two years but no official notice was taken until a recruiting scandal developed—several would-be volunteers with Bisley triumphs to their credit were rejected on the grounds that they were unable to shoot straight.

As the South African situation developed in seriousness, the Government realised that a far larger expeditionary force would be required than it had hitherto envisaged. There was, in consequence, an unprecedented demand for rifles, and new buildings were hastily constructed to house additional machinery. Day and night shifts were instituted and production eventually reached 2,500 a week.

It was during the South African War that Germany, by openly aiding the Boers with arms and money, revealed her ambitions—and her growing envy of Britain and the British Empire. The Government would not or could not see the writing on the wall. A powerful navy—the most powerful navy in the world; that was Britain's pride. But an army as powerful on land as her fleets at sea? Never. At meetings all over the country in the next few years Lord Roberts sounded the alarm but his warnings were as little heeded as were those of Winston Churchill, who, 30 years later, was to preach, as a private M.P., the peril of the new German National Socialism.

In the 12 years before 1914 it became obvious to the British mercantile world that it had something more to contend with than simple German competition in the world's markets; Germany was, in fact, waging a commercial warfare which was intended to strike at the foundations of British industry. Few trades escaped attack, but the brunt of it was borne by those which would be most important to the country in time of war—the iron, steel and engineering industries. Supported at every turn by the Berlin Government, protected by tariff barriers in their home markets, aided by subsidies, bounties, and concessions in transport rates, German firms cut prices so low that contracts were hardly worth securing. British manufacturers, nevertheless, fought back, and German firms were forced time and again to quote below cost price. But profits were a secondary

consideration to the Germans. "Get the trade, put the English firms out of business, the Government will see you through" were their orders. There is, however, a limit to the amount of unprofitable trade which a nation can assimilate and Germany reached this limit, but not before the rate of development in all British industries essential to arms production had been considerably checked.

As the largest rifle firm in the British Empire, B.S.A. was one of the chief objects of this commercial warfare. Everywhere it turned abroad for orders the unseen hand of Berlin could be felt, exercising diplomatic and financial pressure in favour of German firms. In one instance a German contractor undertook to fulfil an order for rifles in so short a time that their manufacture was utterly impossible. Yet the arms were delivered at the promised date. Later it was discovered that the German Army had supplied the weapons from stock, the manufacturer replacing them at his leisure. B.S.A. could fight foreign firms but not governments. Scant help was forthcoming from Whitehall, for in the five years before August, 1914, War Office orders for rifles averaged but 7,000 a year—little more than five per cent of the plant's capacity.

B.S.A. might well have found itself in the same financial difficulties as many of the smaller engineering firms had it not been for the non-military side of its business which showed continual expansion. The company, which had become the acknowledged leader in the design and construction of cycles through its manufacture of component parts, placed a complete machine on the market again in 1908 after an interval of 21 years. In the same year it absorbed the Eadie Manufacturing Company of Redditch, famous for its coaster hub. Early in 1910 the first B.S.A. motor cycle appeared, while a few months later acquisition of the Daimler Company consolidated the policy of direct representation in all forms of road transport.

CHAPTER V

THE GREAT WAR

ALL the problems and difficulties which had faced the company in earlier international crises were nothing compared with those of August, 1914. After Britain's small expeditionary force had been armed, the stock of rifles in reserve was only just adequate to meet wastage in the field.

Had hostilities been delayed another year it is probable that the British forces would have been armed with a new rifle. A year before the war the Mark III Short Lee-Enfield, first adopted in 1907, had been so severely criticised in Parliament and elsewhere that the War Office was actually planning to switch to a Mauser and a factory was in course of construction at Small Heath for its manufacture. The war came, however, and Britain had to fight with the only rifle she possessed. Far from the critics being justified, the Lee-Enfield, although considerably shorter than the German Army's Mauser and fitted with a smaller bayonet, quickly proved itself the most efficient rifle possessed by any of the belligerents, particularly for the trench warfare soon ruling on the Continent. Its firing qualities in the hands of the Old Contemptibles were such that the Germans were convinced that they had been misled by their Secret Service and that Britain possessed a far greater number of machine guns than had been supposed.

B.S.A. faced the rifle shortage with grim resolution. By working 24 hours a day and seven days a week, production was stepped up in six months from 650 a week to 4,360. Every day new machines were being delivered and unskilled labour taught to perform skilled operations. By January, 1916, output had risen to nearly 8,000 a week and by the

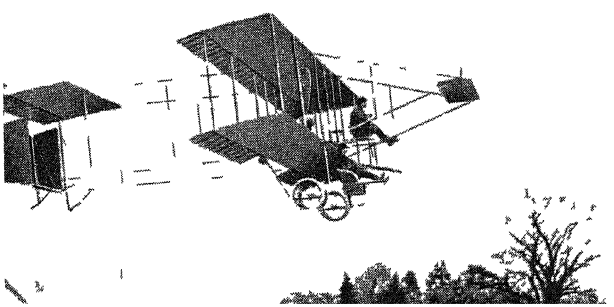
end of the year to the peak level of 10,000 rifles a week. During the war the company manufactured no fewer than 1,601,608 complete Mark III Lee Enfields, together with spares which in the aggregate represented at least another half million weapons.

As serious as the rifle situation in 1914 was Germany's overwhelming superiority in machine guns. With the Lewis gun which it had been developing for some time and which had already been approved by the War Office, B S.A. played a leading part in the gradual rectification of this position.

The company's association with the Lewis gun began a few years before the war, when its inventor, Col. I. N. Lewis, onetime Secretary of the United States Ordnance Board, came to Small Heath with a sample weapon to consult B.S.A. about the problem of manufacturing the barrels. The company's experts realized immediately there were untold possibilities in the development of the gun. Col. Lewis had solved the two chief problems of existing machine guns. By using air-cooling instead of water-cooling and a magazine feed instead of a belt feed, he had produced a light and simple gun which could be carried and operated by a single infantryman. Instead of the recoil system of reloading, the new gun utilized the exhaust gases of the previous explosion.

Indeed the experts reported so favourably that the B.S.A. directors entered into a contract with a syndicate which had acquired the manufacturing rights and the experimental department at Small Heath was at once placed at Col. Lewis's disposal. Eighteen months

◆ *The Graham-White aircraft takes off to demonstrate the Lewis gun, which can be seen just above and in front of the under carriage*



later—in November, 1913—the gun was demonstrated at Bisley to British Service experts and also (regrettably) to foreign military attaches.

◆ *France, 1917—The Lewis gunner is preparing to give a hot reception to a German reconnaissance aircraft*

The first tests were carried out from a Graham-White aeroplane piloted by Marcus Manton with Lieutenant Sellingwerf of the Belgian Army in an improvised seat from which he controlled one of the Lewis guns mounted for firing straight ahead or below. There was a high wind and considerable manoeuvring was necessary before the gun could be brought to bear on the target—a white sheet placed on the ground—but at a height of 500 feet 11 hits were recorded out of 14 shots, a great achievement in view of the way in which the aircraft dipped and swayed in the gale. The gun was also put through satisfactory tests on the ground at the 200 and 500 yard ranges. All types of fire were demonstrated from single shots to full bursts. And to show that the feeding mechanism operated perfectly at any angle the gun was also fired upside-down, sideways, and with the muzzle pointing vertically downwards.

The result of the demonstration was that trial orders were at once placed not only by British but also by foreign governments.

It was providential for Britain that the Lewis gun fell into good hands, for when war came and machine guns were required in enormous quantities, here, ready, was a wonderful weapon. In August, 1914, fewer than 50 men were employed on their manufacture, but by the end of 1916 more than 10,000 machines had been installed in a new factory at Small Heath and output had reached 2,000 a week.

In the war B.S.A. not only supplied all the Lewis guns used by the British land, sea and air forces but also sent numbers to the Russian and Belgian Governments. Its total war production was 145,397 complete guns apart from vast quantities of spares.

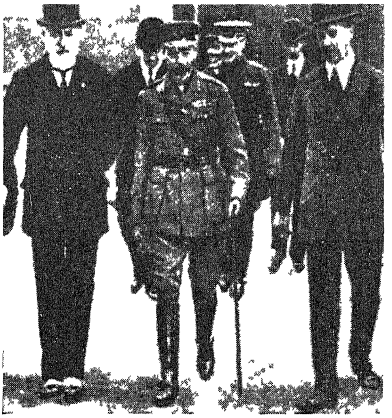
About the middle of 1918 an agitation was started in political circles to replace the Lewis by the Madsen machine gun, an ingenious Danish contrivance of some years' standing, and, in consequence, the War Office staged a trial of these two and other guns at Bisley. After the test, the six members of the examining committee submitted independent reports. And each of them placed the Lewis gun first.

In addition to guns, the company also manufactured great numbers of military cycles—its cycle components had been adopted as standard fittings by the War Office as far back as 1902.

◆ *Lewis machine guns were mounted on sidecars to afford protection against road-strafing by enemy fighters.*

The Army Cyclist Corps soon demonstrated the usefulness of the

ordinary bicycle in warfare, but it was quickly realized that the mobility of large bodies of men would be enormously increased if a machine could be evolved which could be carried over difficult country. B.S.A. designers set to work and quickly produced a folding bicycle which could be packed on a soldier's back in 1½ minutes, thus leaving his hands free to use his rifle. Large numbers of these were at once ordered by the War Office.



◆ *The late King George V at Small Heath in the Great War with the late Sir Hallwell Rogers, then chairman of B S A. (right) and the late Mr. W Baylay, General Manager*

Urgent as was the demand for cycles, equally urgent was the demand for B.S.A. motor cycles which proved themselves on the shell-torn roads of Flanders and France. Even more striking evidence of their strength and endurance was forthcoming from German East Africa, where 400 men of the South African Motor Cyclist Corps were all B.S.A. mounted. Each machine had to carry 140-lbs. of kit in addition to the rider. One expedition involved a journey of 2,800 miles through hostile country over roads which were bush tracks, across swamps of greasy mud, through miles of deep soft sand, into which the machines sank to the footboards, and through rivers which had to be forded because the enemy had destroyed the bridges. Harsher treatment could hardly have been devised, yet all machines came through successfully.

B.S.A. also manufactured a host of other munitions requiring a high degree of engineering accuracy and workmanship, including aero engine and aeroplane parts and the Constantinesco synchronising gear, which enabled a machine gun to be fired through the propeller of an aircraft.

CHAPTER VI

THE UNEASY PEACE

BY the time of the Armistice in November, 1918, the number of company's employees at Small Heath, at Redditch and at Sparkbrook had risen from 3,500 to more than 13,000; its factory space and machinery had been doubled and trebled; it had become one of the greatest light engineering concerns in the world. Its very vastness, in fact, made internal reorganization imperative and, in consequence, the cycle, gun and tool-making sections were incorporated separately*.

With the cessation of arms orders all energies at Small Heath and Redditch were concentrated on the production of cycles, motor cycles and, later, light cars.

These industries have always been very sensitive to economic trends and any improvement or recession in national and world conditions has been quickly reflected in the volume of business. To gain a clear picture of B.S.A. progress in the 21 years between the two wars it is necessary to deal separately with each side of the company's chief activities.

The immediate years following 1918 were difficult for the motor cycle industry; the sale of a few thousand machines then constituted a good year for B.S.A. From 1922, however, conditions at home began to improve, this improvement being reflected in a steadily increasing demand until the company became the largest motor cycle manufacturing concern in the country and was able to adopt the slogan "one in four is a B.S.A."

Side by side with home expansion, foreign markets were opened up, and despite quotas, high import duties,

* See company tree opposite page 5.

depreciated currencies and, later, the competition of subsidized German manufacturers, sales gradually increased until by 1934 B.S.A. were shipping 27 per cent of the total motor cycle exports from this country.

The keynote of B.S.A. motor cycling policy was always reliability, but it was no use resting on the laurels gained in the war; the new models had to be proved in public and to this end the company sent in 1926 two riders with two machines on a world tour, during which they crossed the Andes in a journey from Chili to the Argentine. By the end of their 20,000 mile trip, which lasted nearly two years, they had passed through 24 countries. It was one of the longest and most successful tours ever undertaken on behalf of the British motor cycle industry.

The reputation of the company's products was enhanced by successes year by year in the leading trials and competitions. From time to time machines were submitted to special tests officially observed by the Autocycle Union. In 1938, for example, two machines were selected from machines in stock in dealers' showrooms and submitted to 8 days' gruelling test comprising 20 consecutive non-stop ascents of Bwlch-y-Groes in Wales followed by high-speed touring acceleration and brake tests at Brooklands, then a further non-stop ascent of Bwlch-y-Groes and finally a 35-mile flexibility test across London from east to west and north to south sealed in top gear. For this outstanding achievement the company was awarded the Mandes Trophy for the most meritorious motor cycle performance of the year.

Another convincing demonstration was carried out in March, 1939, when again, in an officially observed test, a solo machine and a sidecar combination made a complete circuit of the coast of England and Wales. Except for one or two stoppages of a minor character, such as obstructions

in the petrol supply, the whole 2,500 mile test, which included 25 ascents of Bwlch-y-Groes in the dark, was completed non-stop by relays of riders.

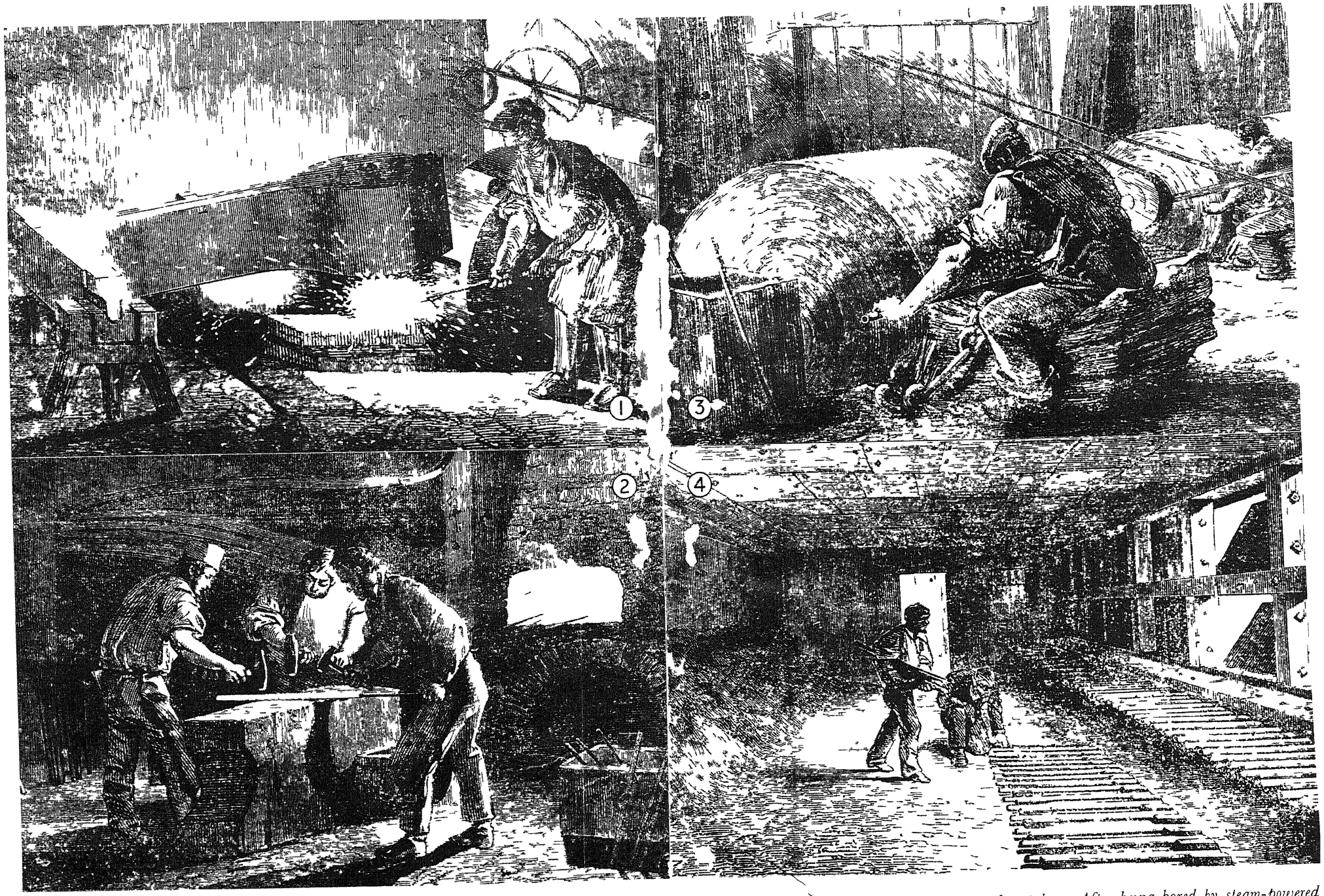
This trial also involved a run for one hour in top gear from London to Brooklands, where on the track both the solo and the sidecar combination completed 100 miles at speed. Even after such a gruelling test as that to which they had already been subjected, the solo machine averaged 73.65 m.p.h., while the combination averaged 48.43 m.p.h. with a maximum lap speed of 50.3 m.p.h.

It was the quality of reliability so amply demonstrated which attracted many public bodies at home and abroad. Contracts were placed by the Post Office, the Automobile Association and many other organizations needing motor cycle transport. The company's machines were particularly suitable for police work and they were bought by Scotland Yard and by many forces abroad, including the South African Constabulary.

The conditions which governed the bicycle market in the peace years were similar to those in the motor cycle trade, except that the competition both at home and abroad was even fiercer.

After the difficulties of the post-war years there began in 1923 a period of tremendous development in the industry. B.S.A. was quick to seize its opportunities but it was an uphill battle, especially in those foreign markets in which Japanese makers competed. They not only copied B.S.A. designs and used identical colours but put on their products the "Piled Arms" trade mark. Action was taken on every occasion by the company but not before vast quantities of spurious products had been sold. This was typical of the Japanese commercial dishonesty with which many exporters of British goods had to contend.

Gunmaking in Birmingham in 1850



The first of these four engravings of gun barrel manufacture and proving in Birmingham in 1850 shows, in the words of a mid-Victorian writer, "a stupendous hammer weighing 3½ tons and moved by steam power" being used to form bars from re-smelted scrap-iron These bars were then rolled cold, cut into appropriate lengths, re-heated in a forge, and passed between convex and concave rollers, the latter process causing them to assume the shape of a barrel A mandril or long iron bar was next passed through them and when they had again been heated in a furnace they were welded (2) into seamless tubes After being bored by steam-powered drills they were ground (3) on grindstones revolving with "dizzy velocity" Before the locks and stocks were fitted the barrels were proved and stamped in the Proving-House, established in 1813 by Act of Parliament at the instance of the Birmingham Gunmakers' Company There, in a special building (4) lined with iron-plates, each barrel was tested with a charge from three to five times greater than that which would be used in normal service

As with motor-cycling, the company had constantly to keep its name before the cycling public. One of its most successful efforts in this direction came in 1934 when the Australian rider, Hubert Opperman, who was associated in the Commonwealth with the distribution of bicycles made with B.S.A. fittings, was brought to England to attack various long distance records, including the famous Lands End-John o' Groats test, which entailed a ride of 865 miles, a strenuous and punishing ride. Opperman began by breaking in a short period of five weeks first the London to York and the 12-hour records and in one superb ride the 24-hour, the Lands End-John o' Groats and the 1,000-mile records.

In the light car field, which the company entered in 1921, considerable success was achieved, especially in the early '30s with a 9 h.p. three-wheeler—forerunner of the famous front-wheel drive four-wheel "Scout".

Because of its wide interests the company fared better than many of its rivals during those years of uneasy peace but even so it was a constant struggle to achieve the results it did. Unlike its competitors, B.S.A. had a duty to the nation as well as to its shareholders. It was this sense of responsibility which caused the board to maintain a large quantity of rifle-making machinery. Year after year the cost of this appeared on the debit side of the balance sheet. (A new director who once challenged the entry was merely reminded by the chairman of the title of the company that there was something which ranked above an addition to the credit side of the balance sheet).

For nearly 17 years the rifle plant remained idle until in 1935 a contract for 16,000 Lee-Enfields was placed by the Ordnance Board on behalf of the Iraqi Government. The Board appeared to have some doubt whether the order could be completed in less than two years owing to the state

of the plant and the apparent lack of a sufficient number of skilled rifle workmen and a delivery date was demanded. The company replied with a guarantee that the first batch of 50 would be ready in four months. With such scepticism was this guarantee regarded in some quarters that a number of wagers were made as to whether the first guns would be made in the stipulated time.

At Small Heath the custom in the barrel-boring and rifling shops had been for son to succeed father and grandson grandfather but owing to the depression in the small arms trade the sons and grandsons at this period had begun to specialize in motor engineering and the other 999 trades to be found in Birmingham. However, the company set to work and after combing every shop eventually assembled 44 old workers with experience of the various processes of rifle manufacture. It was not expected that they would be able to demonstrate at once all their old skill and speed—they were returning to the work after a gap of 16 years—but they would form a trained nucleus which could be diluted with younger men fresh to the work. Production started and within 15 weeks the first 50 were ready. But it was believed by those not in close touch with Small Heath that the rifles had been assembled from spares and not genuinely manufactured. When regular deliveries followed, however, they were duly convinced and settled their wagers.

The Lewis gun machinery remained as idle as the rifle plant throughout the years and although the company manufactured sporting guns and air rifles the small arms section of the factories during this period was the very reverse of profitable.

CHAPTER VII

AT WAR AGAIN

THE same spirit of responsibility which had caused the board to maintain the rifle and Lewis gun plant idle through the years lay behind its decision to adopt the recommendations of the men they had sent to Leipzig. "We are going to be forced into war", this report had stated, "and we must have a substantial sum to bring the organization up to date and to fulfil our obligation to the country." And so B.S.A. started to prepare for the second world conflict.

The actual date of the declaration of war is not of exceptional importance in the story of B.S.A.'s war effort; the frenzied exertions of August, 1914, were unnecessary, for the planning office and tool room had been on overtime for three years; a seven-day week with overtime had been worked for months in those sections of the plant already manufacturing armaments; in some shops a night shift had been operating for a year. September 3, 1939, certainly saw the introduction of the blackout and the institution of A.R.P., but much more critical dates lay ahead in the latter half of 1940 when the Luftwaffe attacked the works.

At the outbreak of war the company, apart from research work on various secret weapons, was already producing a formidable list of armaments including:—

At SMALL HEATH Browning machine guns, Boys A.T. rifle and magazines, Lee Enfield Mark III rifles and magazines, Bren gun parts and magazines, Fuses, Primers, 40 mm. shells, Exploder containers, 2-pounder gun carriages.

At the new REDDITCH FACTORY, Besa 7.92 machine guns, Besa 15 mm. machine guns.*

* The old Redditch factory, original home of the Eadie Manufacturing Company, had been disposed of in 1928 and its motor cycle and cycle component shops transferred to Small Heath.

On the outbreak of war the Small Heath and Redditch factories slid smoothly into full operation. Night shifts, which for the first time since 1918 included women operators, were instituted throughout the plant. Output for civilian purposes was drastically cut before being entirely eliminated, and the machinery and labour thus released were turned over to war production. Every day saw further expansion in plant, equipment and personnel. Ambitious production targets were beaten only to be superseded by still higher aims. No matter how great an achievement appeared it was regarded merely as a challenge to the workers to surpass it.

The production difficulties occasioned by the expansion of the country's armaments programme fell most heavily perhaps on the planning engineers. Their task was not only to scheme the manufacture of a weapon from the designer's drawings and to authorize the purchase of raw materials but they were also responsible for a sufficiency of machines and tools.

It was in the provision of the machine tools that one of Britain's chief problems lay. Months before the war an acute shortage was developing despite the efforts of our manufacturers to increase production of the types most needed in the event of hostilities and by September 3, 1939, there was a lag of as much as 72 weeks between the placing of an order and the promised date of delivery.

The French were in no better position and from the time they started to function both the British and French Purchasing Commissions in the United States were buying every suitable machine they could find in an attempt to make up their countries' deficiencies.

On the collapse of France the British Commission not only took over all the machines ordered by the French but ships already on the high seas with equipment for France

were intercepted by the Royal Navy and escorted into British ports.

The task of allocating the new machines was obviously a matter for official action and the Machine Tool Control was instituted to distribute them on a priority basis, according to the war needs of the moment as advised by Service experts. Through the foresight of the B.S.A. management in ordering great numbers of machine tools at a period before the war when the demand was not so great, the company in the early stages of the struggle was in a more fortunate position than many other great engineering companies; in fact, it can be said that up to the time of the Battle of Britain the machines were being obtained as quickly as they could be put to use.

B.S.A.'s fortunate position in this respect, however, ceased with the start of the blitz. In a raid on Small Heath on August 26, 1940, some 750 were destroyed or damaged. Replacements were just beginning to arrive in November when in two devastating raids within three days a further 1,600 were destroyed or damaged—more than were lost in the whole of the famous Coventry blitz. Most of the machines destroyed at Small Heath were engaged on rifle and Browning gun production and their replacement at once became a matter of first priority.

There were many incidents in those days of which the full humour could not be appreciated at the time. On one occasion, for instance, B.S.A. was given the number of a rail wagon into which an urgently required machine had been loaded at the docks. The railway company was pressed to accelerate the arrival of the wagon and by dint of much telephoning it reached Small Heath in record time. But when it came to be unloaded it was found to contain ten tons of coke. Within 24 hours an exchange had been effected with a coal merchant who had received a beautiful machine in place of fuel.

CHAPTER VIII

THE LUFTWAFFE ATTACKS

IF there was one plant more vital than another to Britain and the Empire on the capitulation of the French, it was that of the Birmingham Small Arms Company. Rifles and other weapons were needed in astronomical numbers. The survivors of Dunkirk had to be re-armed, more divisions had to be hurried to the Middle East to hold Mussolini's armies in Libya and Abyssinia, the ever-growing forces at home had to be equipped to meet the new peril of imminent invasion; arms were required in hundreds of thousands for the Home Guard.

The few brief months in France had proved to the members of the Air Council that in the Spitfire and Hurricane with their armament of Browning guns they had two fighters superior to anything that Germany could pit against them. But they were so few as yet compared with the enemy's hordes. Our aircraft factories were working at the same feverish pitch to turn out new planes as was B.S.A. to arm them with Brownings—and to keep them armed. Directors, managers, staff, operators—all knew the position. If they had to fight on the beaches, in the fields and in the streets—they would at least have some weapons. Such was their determination.

After Dunkirk, in fact, every employee agreed willingly to work seven shifts a week, days or nights. And they continued to do so until sheer exhaustion forced them to revert to a six-shifts-a-week system.

By the middle of July the Luftwaffe was beginning to carry out night attacks on our cities and towns. Although not heavy raids, judged by the standard of the blitz to come, their implication was obvious to the Small Heath manage-

ment—they would be intensified and would be concentrated on the chief manufacturing cities. Dispersal of vital plant from Small Heath had already begun when on the night of August 26/27—less than 36 hours before the opening clash of the Battle of Britain—the Germans raided Small Heath, causing the gravest damage at B.S.A.

The first bomb, a high explosive, hit the main barrel mill, the only one operating on rifle barrels in the country. Fire followed the bomb and the flames gained a ready hold on the oil supply system. The building was doomed from the start, but, as if to make doubly sure, a shower of incendiaries fell into the centre of the fire to add fresh fuel to the flames.

Twenty minutes after the mill had been hit an oil bomb crashed into the neighbouring fuse inspection shop. Here too a big fire was soon blazing but it was prevented from spreading to the chief fuse production shop and to the main offices.

If there was any consolation in the results of the attack, which destroyed the mill together with five machine shops all engaged in Browning and rifle manufacture, it was that part of the barrel plant had been moved a few weeks previously to a basement shop in another part of the works.

From this, its baptism of fire, the works fire brigade emerged triumphant. Three years before the outbreak of war there had been planned at Small Heath a comprehensive Air Raid Precautions Scheme. On the actual declaration of war there had been a rush of volunteers which brought the organization to full strength. In addition the works' branch of the St. John Ambulance Corps had accepted responsibility for all First Aid measures.

In one vital respect no Air Raid Precautions Scheme was to prove self-sufficient in the war. The first attacks by the Luftwaffe showed that in all cases of major fires it was invariably necessary to ask for outside help. It was not just

a case of a firm calling on a municipality for aid; throughout the blitzed areas of the country town called on town, and city on city.

Early in that first raid additional squads were requested from the Birmingham Fire Service Controller. Although overwhelmed by outbreaks in all parts of the city—he had already sent an appeal for reinforcements to other towns—he responded at once to the company's S.O.S., and by the time the Small Heath fires had been brought under control many pumps not only from Birmingham but also from places as far away as Bournemouth were in operation.

When the raids began, the management impressed on the workers the fact that they were now in the front line, that the enemy's object was to prevent them making the guns so vitally needed, and that, although there was no such thing as complete security, every effort had been and would continue to be made to ensure their safety. It was the company's duty to make such a statement, but it proved almost unnecessary since even in the first few nights more than 80 per cent of the employees remained at their machines until ordered to the shelters by warnings of imminent danger; within a short time all but a fraction of one per cent continued production. That this fine response was purely voluntary is proved by the fact that notices were posted in every shop stating that on the sounding of a siren, anyone was free to take shelter *and was not to be criticised for so doing.* But the workers knew just how desperate was the nation's plight.

The decision as to whether danger was sufficiently imminent to order evacuation to the shelters was left to volunteer roof spotters selected from employees, who manned posts on the highest points of the factories immediately on receipt of a "yellow"—raiders approaching—warning. This roof spotting eventually became compulsory throughout the country. The Small Heath system of working in raids till

the last possible moment actually anticipated by many weeks the Government's own guidance on the subject.

It is a tribute to the workers that even during the worst period of the raids absenteeism from both night and day shifts was always within very narrow limits, despite frequent home tragedies as a result of the air attacks and the continual disruption of transport services.

A visit to the Small Heath plant during those blitz nights of 1940 and 1941 was a never-to-be-forgotten experience. To those privileged few from the outside world who were permitted from time to time to see the workers of a great armament organization triumphing over the Luftwaffe it was both a revelation and an inspiration. Here is an account of such a tour made during one of the first heavy raids on Birmingham:—

We begin in the New Building—new in the Great War and so termed then to distinguish it from the rest of the works. It is a vast four-floored structure in three 200-yard-long blocks.

First we come to an inspection department on the top floor of one of the blocks. Here women predominate. They do not appear to be disturbed by the fact that there is only a reinforced concrete roof between them and the raiders. Most of them sing as they handle their gauges swiftly and expertly to test mountains of components for accuracy of workmanship. Their singing is like a community concert with the barrage providing a macabre accompaniment.

The singing is suddenly interrupted by the blare of the internal siren, a signal for everyone to be ready to evacuate at the next warning. (At this stage of the war it is impossible not to be affected by the sirens although later we were to become inured to them). The foreman is a volunteer spotter; he hands over to his deputy, collects his steel hat and greatcoat, and goes to the roof.

We pass from block to block, from floor to floor. Thousands of machines line our route—millers, grinders, drillers, heavy and light automatic machines, presses — most of them engaged on Browning gun production.

Many of the workers are comparative newcomers to engineering. There are married women who have to cook for their families before they come to work and when they go home, girls fresh from school, ex-servicemen, men who have had their own businesses, men from other trades. And then there are the old hands who provide the new labour with a leavening of solid experience and stability.

Apart from the raid there is evidence of the "carry on" tradition. A woman is pointed out to us. She is an excellent worker. In a raid only a few days ago she lost her home and all but one of her family. But she is back at the bench with a grim intensity. This concentration on her job is helping her momentarily to forget the tragedy that has come upon her.

As we pass along a welfare worker is advising a girl at a machine that she must give up work soon. She looks young to be having a baby. She met her husband, a rear gunner in the R.A.F., while they both worked at the factory. He's now using the guns she has been helping to make.

In some of the shops the atmosphere is bad because of the blackout. Experiments are being made with improved ventilation systems. (Here a story must be interjected. Despite all that the engineers could do there was one shop at Small Heath which always became unbearable in the summer nights. So hot was it, in fact, that the girl operators adopted the habit of partially disrobing under their overalls. One night the inevitable happened. The overalls of one—the prettiest of them all—became caught in her machine and she had to stand there, clad only in the scantiest of undergarments, until released by a fitter. From that moment

the girls became more careful in the articles they discarded, many of them wearing bathing dresses beneath their overalls).

To continue the tour. At one point a foreman and a chargehand are standing by a machine tool. An unforeseen difficulty has arisen in connection with the machining of a new component. The night superintendent, who has been told of the problem, arrives. In a few minutes a solution is found and a fitter is making adjustments to the machine, which is soon operating again.

As we leave the New Building we hear the droning of the enemy bombers; searchlights are weaving a sky lit by the flashes of exploding shells.

At the surgery the sisters are all ready to go to the main dressing station should evacuation of the shops be ordered. Our guide talks to Central Control over the A.R.P. telephone: "Nothing very near Small Heath so far but several fires the other side of Birmingham."

We move on. In a shop where shell fuses are being made big machines are steadily turning. The night shift is trying to beat the day shift's output figures. Glass roofs here, blacked out and wired, but shell splinters have come through several times. Into shop 64, the biggest at Small Heath: "What are those odd looking things?" The answer is appropriately vague. "Oh, just a job" . . . (on the Secret List).

We pass through building after building. Everywhere it is the same story—production, production, production. Occasionally a worker will pause as there is an ominous thud and the floor and machinery shudder. "Was that near my home? Are my folk safe?" Their thoughts are obvious. But it is no use speculating. On with the job.

No finer example of the carry-on spirit existing throughout the B.S.A. organization can be given than that of a mill-

wright. News was received in the middle of a raid that a bomb had dropped in the street where the man lived. The night superintendent insisted on him going home to see whether his home was intact. In a couple of hours he was back on duty. Still smiling grimly, he said "It's gone all right". He explained that his own family and that of his mate who lived next door were safe, but all that remained of the two houses was a mass of bricks and rubble. "But", he added, smiling even more broadly, "wait till my mate knows that his house has gone as well. I haven't told him yet. He won't half be wild."

We visit Central Control to get information—our guide is constantly being asked where the bombs are falling. Control calls the spotters for us:

1X?—"1X answering. Everything O.K."

2X?—"2X answering. O (a hesitant pause) K."

5X?—"5X answering. Raiders now coming in this way". We pause outside. Yes, there are more planes about. We climb to the 5X roofspotter, whose post is the highest point of the factory. Things are certainly happening. Much too close for our liking is a huge fire, for which the next wave of bombers will certainly make.

Down again and we continue the tour. Suddenly while we are walking through a shop the machines slow down and stop. The power has been cut off, which means "danger imminent". Everyone must go to the shelters.

All civil defence volunteers move off to their posts while evacuation marshals take charge of the rest of the workers. A few, anticipating a quick return to work, stay behind. It is not easy to induce everyone to take cover, for some people want to stand and gaze at the searchlights and bursting shells.

We go into Shop 64 Basement, which is crowded—many workers prefer it to the proper shelters. Here the barrel-

drilling machines brought from the mill before it was destroyed in August are still running. Their output is so vital that special arrangements for a supply of power have been made.

The order to go to the shelters has come near the meal interval so that production will not be affected as much as it might have been. There are many who have not brought any food. For them the canteen workers do a wonderful tob and it is not long before they arrive with sandwiches, buns, tea and coffee.

In both the smithy and hardening shop the men are also still at work. They have to carry on—by the light of lanterns if necessary. Otherwise the temperature of the furnaces would drop and considerable loss of output result.

We go back to the 5X spotters' post, calling in on our way at the New Building where a number of people are sheltering on the ground floor. There are blast walls outside and it is considered as safe as any specially built shelter. (It was here that later in the year there was to be stark tragedy).

At 5X we learn that the Central Controller, after consulting the spotters, has advised the management that it is considered safe to resume work and the order is given to the electricians to switch on the power.

Arrangements for a speedy resumption are very effective; so effective in fact that other firms have sent representatives to Small Heath to see whether the B.S.A. methods can be applied in their own factories.

Soon production is in full swing again and with luck the workers will be able to continue for the rest of the night without further interruption.

So ended the tour. It was a typical night in the Battle of Production fought not only at Small Heath but at a thousand and one other factories, great and small, throughout the country.

CHAPTER IX

THE GREAT BLITZ

DESPITE the August bombing of the barrel mill and the numerous subsequent incidents—in October a building housing the motor cycle and cycle stores and the Oerlikon and Hispano Suiza cannon drawing office was damaged—still no government order came for full dispersal. The management carried on but not without grave misgivings.

Then in the latter half of November the great blow fell. The Luftwaffe, in two of the severest raids ever experienced at Small Heath, came within an ace of achieving what would undoubtedly have been one of its greatest successes in the whole history of its bombing of Britain's was industries.

On the night of Tuesday, November 19, two direct hits were registered on the New Building, wherein was housed a considerable proportion of the Browning gun plant in addition to sections engaged on the manufacture of Boys Anti-Tank rifles, Bren and Besa components, Lee-Enfield rifles and motor cycles. Three nights later on Friday, November 22, the B.S.A. works were again the main target and once more the chief damage was the destruction of shops devoted to these weapons.

The Tuesday night raid, like others on the Birmingham district in the previous week, began early, the first warnings being sounded at 7-15 p.m. The enemy were using both incendiary and high explosive bombs, and with great fires soon raging in the surrounding neighbourhood it became obvious that the B.S.A. works, silhouetted in the glare of the flames, had been singled out as the chief target for the night. The order was given for the machines to be stopped and for the workers to go to the shelters.

During the first two hours of the attack showers of incendiaries continually fell in the factory area, but the A.R.P. men were ready. They had had plenty of experience of dealing with them in earlier raids and on this, as on the previous occasions, every single one was smothered.

At 9-25 a plane, after dropping a long line of incendiaries a quarter of a mile away, started to circle the works. Suddenly it began to dive and above the scream of the engines could be heard the ominous whistle of bombs. At 9-27, almost simultaneously, there came three blinding flashes, followed by the roar of explosions. The southern end of the New Building seemed to rise and shudder and then to disintegrate as the floors and walls of one block collapsed in a mountain of falling machinery, concrete and twisted steel girders.

In those first few minutes it was impossible to tell how severe was the damage—a cloud of dust and black smoke blotted out the building. Soon it was established that two bombs had hit the southern end of the building, one exploding on the second floor of the middle block, the other landing at the base of the block nearest the canal, completely demolishing a 14-foot blast wall built round the base of the factory. The third bomb had missed the New Building but had fallen near a row of cottages belonging to the company.

To the thunder of anti-aircraft guns and the incessant rumble of high explosive bombs, reinforcements of firemen, rescue teams and first-aid workers were directed to the scene from other parts of the works. As shocked, dazed and injured men and women were led or carried from the middle and northern end of the building, it became known that a large number, how many it was impossible to establish, were trapped in what had been the ground floor of the outside block. They had taken shelter there, mostly amid heavy

machinery. (It was later learned that an impromptu concert led by an accordion player was in progress when the bombs fell.)

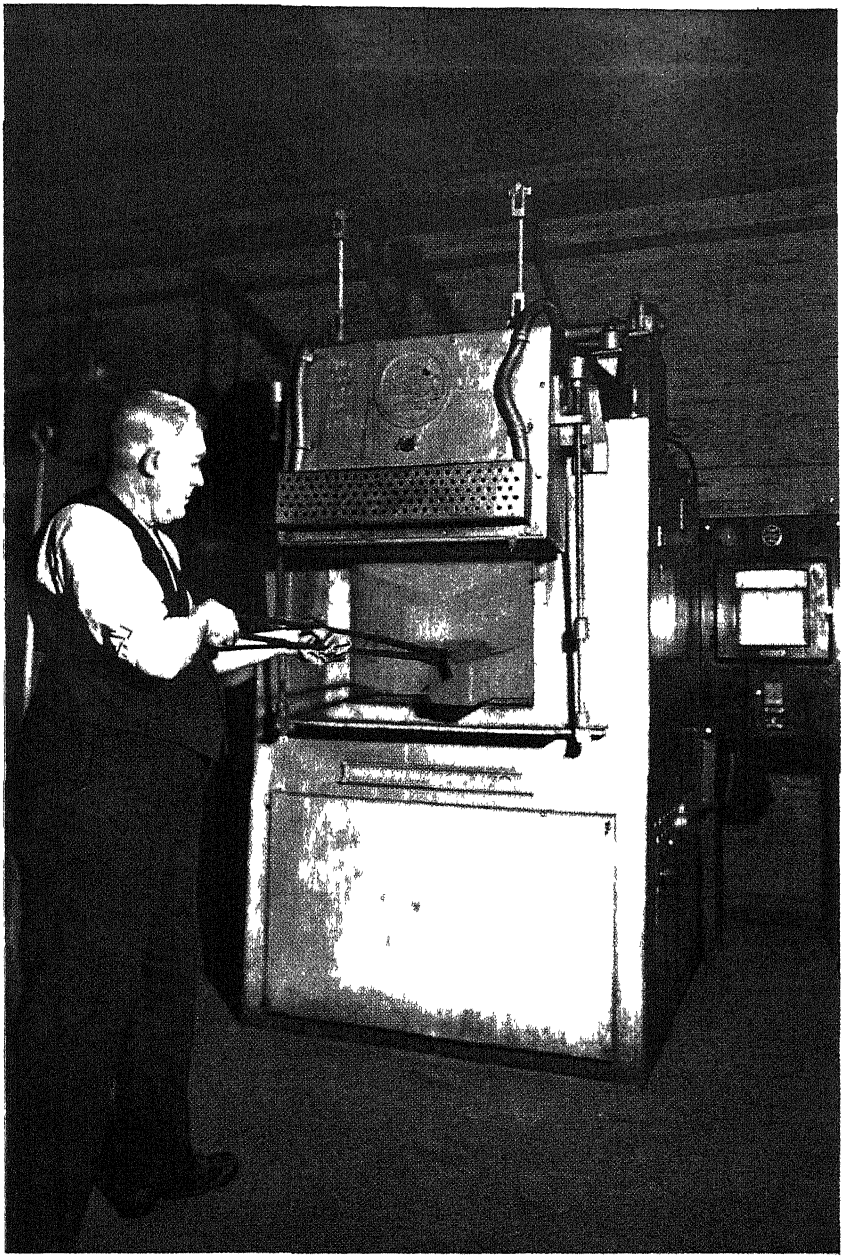
Fifteen minutes after the building had been hit, fire added to the horror. This outbreak was probably the result of the smashing of hurricane lamps used for illumination by A.R.P. patrols in the shops during alerts.

The cries for help of the trapped men and women now began to be mingled with the crackle of flames, which, fed by oil dripping from smashed machines and broken piping, rapidly gained a hold. This was not all. A large quantity of ammunition from a 100-yard Browning accuracy test range on the roof of the building had been precipitated into the wreckage; as the fire spread this started to explode, giving the impression that the raiders were machine-gunning the works.

The first problem was to try to get the fire under control At all costs the rest of the New Building had to be saved and an S.O.S. was, therefore, sent immediately to the Birmingham Fire Service Controller. As had been the case in the August raid, the response was immediate. Before 10 o'clock 20 additional pumps had arrived at Small Heath; by 10-30 there were more than 60, many of them from fires at other factories. That decisions to divert fire fighters from one outbreak to another had to be made was part and parcel of the new type of warfare.

B.S.A. pumps were on the scene within less than a minute of the first sign of fire, but before they could be started hoses had to be dragged over the mountains of masonry, twisted steelwork, and machinery which lay between the building and the nearest source of supply, the Birmingham and Warwick Canal on the south-western boundary of the works.

Meanwhile rescue parties had been searching for a way to reach the trapped workers, but every entrance was completely



◆ *Removing Besa breech blocks after case hardening in an electric furnace*

◆ *Woman charge-hand stamping 117 fuses with identification marks*

blocked by debris, which would have taken not hours but days to move. A suggestion that dynamite should be used was considered but rejected. Then it became known that a young Home Guard private, Albert Bailey, had found a possible means of ingress.

Bailey had already effected six rescues that night. Using his rifle as a crowbar to prise his way through debris, he had succeeded, with the help of two other Home Guards, in extricating five men and a girl. While near the place from which he had brought out the girl he had noticed a hole low down in the rubble. He returned to the spot and squeezed his way through the opening only to find his further progress stopped by a huge slab of concrete. From the other side of this barrier came the sound of voices. Suddenly he saw that the slab was not quite so solid as it looked. He was able to tap a hole in it and through the aperture he thrust his torch, shining it into the blackness beyond. His wrist was immediately seized by a hand. Four men and a girl were huddled on the other side. Seizing a bar of iron he began to enlarge the hole but soon came to a steel girder which stopped all further work. An oxy-acetylene cutter was the only way to get through this obstacle.

This then was the news he brought to the rescuers outside. Soon he was back in the hole with Arthur Stevens, an electrician, and an oxy-acetylene apparatus. They saw that at the bottom of the slab was a space of a few inches through which a hand covered with black oil was feebly moving. By this time the fire above was burning fiercely; the heat was intense, so fierce in fact that their clothes began to scorch and the smoke was suffocating. As they set to work other members of the rescue party crawled along the hole bringing with them a hose which they kept playing on them. Stevens, although not accustomed to the cutter, was making steady

progress. But it was a slow job. It was not a question only of cutting through one girder but also others beyond it. At one time Bailey had to stand with his hands above his head supporting a piece of masonry which threatened to fall and trap both of them. A sudden shifting of the debris, however, made it secure.

Eventually a way was cleared. The trapped men insisted on the girl, who was farther from the hole, being rescued first. They flattened themselves on the floor to allow her to crawl over them to where Bailey and Stevens were waiting to help her through. She was covered from head to foot in a black mess of oil and water—but she was safe.

The rescue, however, was not yet complete. The girl, who was slim, had been able to squeeze through the hole but it was still too narrow for the men. Again the process of cutting steel away started. A new complication arose. The two rescuers were being scalded as water from the hoses being played on the fire above trickled through the hot debris and steadily dripped on them. Bailey crawled back and stopped the firemen for a few minutes. At long last the hole was large enough and the four men were brought out. One of them, an elderly man, who was near suffocating with the smoke, was extricated in his underclothes. His trousers had caught on the jagged ends of the girders and Stevens had to cut his belt before he could be dragged through.

The rescue was effected not a moment too soon, for as the last man crept from the hole there was a rumble and the hole was filled with a mass of blazing wreckage.

That was the end of the night for Bailey. On emerging he collapsed and was at once carried to an ambulance. But for Stevens another ordeal was to come. Scarcely had he returned to his post when another call came for volunteers for a further rescue attempt. Shouts for help had again

been heard in the debris. A party was quickly formed—a millwright, Arthur Harris and four electricians, Stevens, A. Goodwin, T. Hoof and N. Finlow.

On their arrival they were given mackintosh capes and helmets before they once again began tunnelling—this time on the other side of the building. Even the optimistic leader of the fire squad thought their task hopeless, but, hopeless or not, they were determined to make an effort.

As the hole was enlarged, so A.R.P. men crept in behind the rescue squad, forming a human conveyor, to pass back the pieces of steel and masonry as they were prised free or cut away.

By the time they had burrowed a depth of some five feet, Stevens was working upside down and Harris and Goodwin holding his ankles. Soon they could see the trapped victims through a gap in the mass of girders. A man and girl were lying pinned under a heavy wooden bench. Theirs was a long-drawn-out agony; four hours were to elapse before they were to be rescued. Five or six times Stevens was forced to stop while Hoof, Finlow and Joseph Topham, a Home Guard sergeant, took it in turns to play hoses down the hole to drench the man and girl whose clothes kept starting to smoulder. The sparks from the cutter did not improve things for them but Stevens had to carry on. Eventually he was able to get close enough to saw the bench in half, but even then he could not move it owing to the weight of girders resting on each end. After a few minutes a rope was obtained and fastened to one half of the bench, which was pulled free by the rescue team behind using tug-of-war tactics.

As in the first rescue, the man, although nearest the hole, asked that the woman should be rescued first. As it happened this only complicated the rescue. As she was pulled out the

man, in rolling over to make way for her entangled his overcoat in the debris and there was no room for him to take it off

Stevens, who was again being held upside down by the ankles, managed to get his hands under the man's armpits and shouted to Harris and Topham to pull him It was only at the third heave that the trapped man was jerked free. This was not the end of the victim's troubles for when half way up the hole a piece of concrete, dislodged in the struggle, fell on his head. He went limp in Stevens's arms, but after being shaken, revived and murmured "Go on—pull away". At last they had him at the top and out in the open.

Again the rescue was effected only just in time for, as the man was placed on the stretcher, the sides of the hole in which they had been working caved in.

Amid all the tragedy of that night there were flashes of light relief. On his return to work the next day Stevens reported that his wife, not knowing what had happened at Small Heath, had rated him soundly for "getting his clothes all messed up".

No word could ever express the full horror of the ordeal of the men and women trapped in the shop. Some impression of what they went through can be gathered from the story of one of the last to be rescued. Here are extracts from his account:—

I was lying on a bench, sharing it with two other men and listening to the accordion player, when suddenly there came a dull thud. Bright lights stabbed the darkness for a second Then followed a rumbling noise as if the whole building were crumbling The one thing we had always feared had come about There had been a direct hit

What happened next I don't know for I must have been knocked out When I recovered consciousness, I found myself still lying at my end of the form My two companions, however, were on the floor crushed to death under a steel

girder Had that girder been straight I should have been killed too, but it was curved and the curve, which was only a few inches above my chest, was keeping a mass of debris from falling on me One of my feet was held fast under a piece of steelwork and it took me an hour of desperate struggling before I managed to wrench it free And as I struggled there came from all parts of the basement shouts for help mingled with the groans of the injured and dying

But once my foot was free it seemed that I was no better off, that we were all doomed I joined in the shouts for help, but little did we realize the mountain of ruins above us No one from outside could possibly hear our cries

To add to our plight fire broke out There could be no escape now I sat there watching the flames, wondering how long it would be before everything around me would be alight Presently I noticed that, in falling, a machine had formed a small arch Under this I wriggled—at least I should be safe from anything that might fall The fire was now burning the form on which I had been sitting the shouting and the groaning were stilling into the strange hush of death

The smoke began to get down my throat Then I felt a trickle of water falling on me I realized firemen were at work with hoses But it was hopeless. I began to pray

Next I found that one of my boots was on fire It took me some time to drag my leg back and put out the smouldering But what was the use of trying to delay the end? I thought of knocking myself unconscious—at least I should not feel death But the natural instinct of self-preservation was too strong and I abandoned the idea (even if I had been able to put it into effect) despite the seeming hopelessness of my position Soon parts of my clothing began to singe and I became frantic, for in my archway I had no room in which to turn

Suddenly I noticed the smoke blowing away from me and that the air was clearing I realized that if I kept under my arch the fire would burn away from me. This calmed me and I decided to have a smoke I still had my pipe and after a lot of twisting I got my tobacco and matches from my pocket The tobacco was fairly dry although by now I was soaked through by water from above I filled my pipe but the matches were damp I held them near a hot cinder until they caught alight That first puff at my pipe was wonderful

Water was now beginning to collect on the concrete floor on which I was half sitting, half lying

Hour by hour went by Sometimes I shouted for help but not often; it was too exhausting The silence was almost terrifying there was no groaning from the other victims now Suddenly after one bout of shouting I thought I

could hear an answering cry. I became frantic and shouted still louder I listened. I was right Faintly I could hear someone answering me but the voices sounded miles away. Gradually they became clearer and after a while I could make out that they were asking me where I was I shouted out my position I could hear them telling me to keep my spirits up

Then there were rumbling noises above me, and I realized they were moving wreckage to get at me. I waited. It seemed hours. Why didn't they hurry? Little did I know the amount of debris they had to shift I was now excited and kept crying out to them Then I could hear them shouting down a small hole, almost over me They asked me if I were injured or crushed, I told them I was all right except for the fire

Then they started to cut away twisted metal and machinery until they could see the light from my torch Within half an hour they had managed to make a hole over me through which I could have squeezed but I had to tell them I could not stand up, that I was pinned in They burned away more metal and then dropped down a rope I caught hold of it and they pulled me up and up until my head was through the hole. Then they grabbed my arms and dragged me through the hole to freedom I asked the time It was 5-45 I had been down there for more than nine hours

Several rescues from the middle block were effected by J. H. Beattie, a corporal in the Home Guard, who had just returned to the New Building when it was hit. As the bomb exploded the sheltering workers dived under the nearest machines. Beattie picked himself from under a bench where the blast had blown him and hurried towards one of the wrecked shops. He found the entrances blocked by debris but there was a hole through which he managed to force his way. Inside he found a shambles.

Some of the injured were crying for help, others could only groan. By the light of his torch he could see legs and arms of women and men protruding from overturned machines. Some were dead. He was clambering over the wreckage when he found a woman covered with plaster and dust. She was whimpering with shock but otherwise unharmed. He took her to the hole, through which she was assisted by other rescue workers.

Four times Beattie went back, each time bringing an injured worker out with him. The last was a woman who begged him to go back for her two daughters who had been with her when the bomb fell. He did so, but they were both dead, crushed by a machine. Here too fire had broken out and each time he entered the flames had gained a firmer grip. He tried to go back a sixth time but it was impossible; the shop was a blazing mass.

Throughout the night rescue parties in ones and twos ceaselessly probed the barrier of wreckage. For the most part their work was fruitless, but they never gave up hope of effecting further rescues. Hours after the bombs had dropped, Samuel Ashburner, a fitter, suddenly saw a woman's foot moving under a machine which, in falling, had pinned her to the floor. With the assistance of another man the machine was raised sufficiently for the victim, who had been severly injured, to be pulled free. Several rescues were also effected by Ernest Williams.

Before helping Stevens at the New Building, Sergeant Topham and two other Home Guards formed a rescue team to go to B.S.A. Waverley Works, where five men were trapped in a shelter under a railway bridge. It was found that the bridge had received a direct hit and that the explosion had killed one man and injured the others. By dint of almost superhuman efforts they tunnelled a way through the rubble and one by one brought out the four survivors.

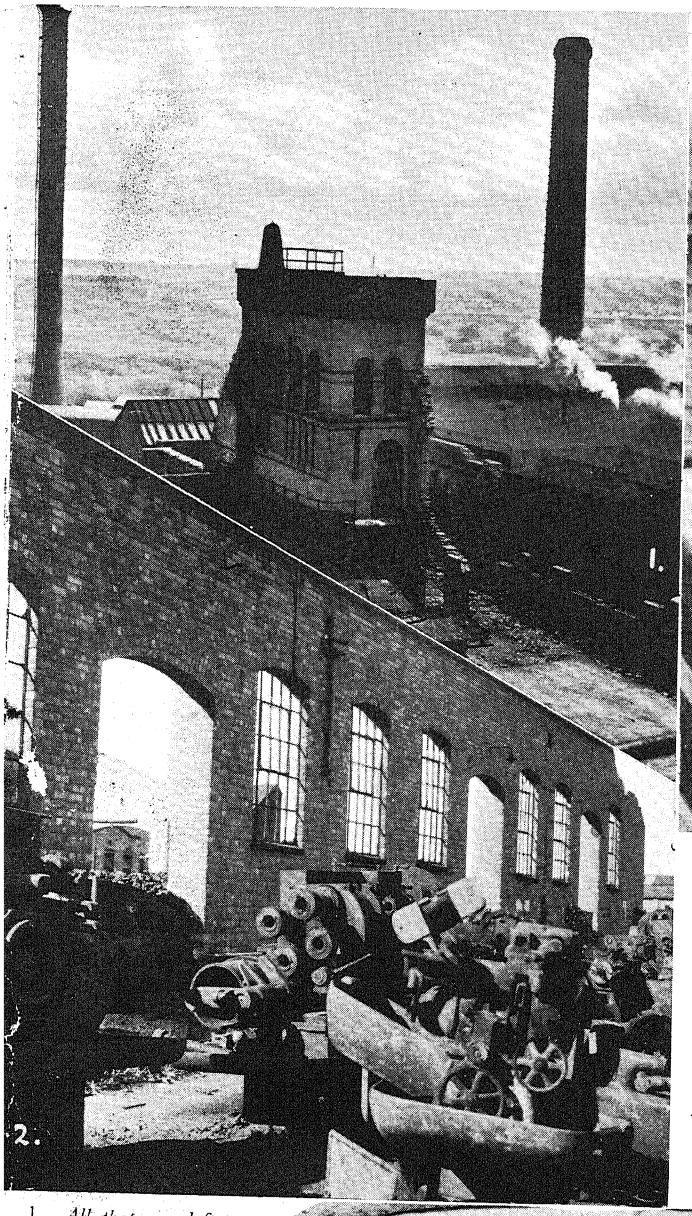
For the workers in the shelters at Small Heath the night proved perhaps an even more nerve-racking ordeal than for the rescue teams; they knew what was happening at the New Building but they could not help. All they could do was to wait, wait, wait. Then came the time when they too had to show a more active courage. With the enemy continuing to make a target of the works it was decided to

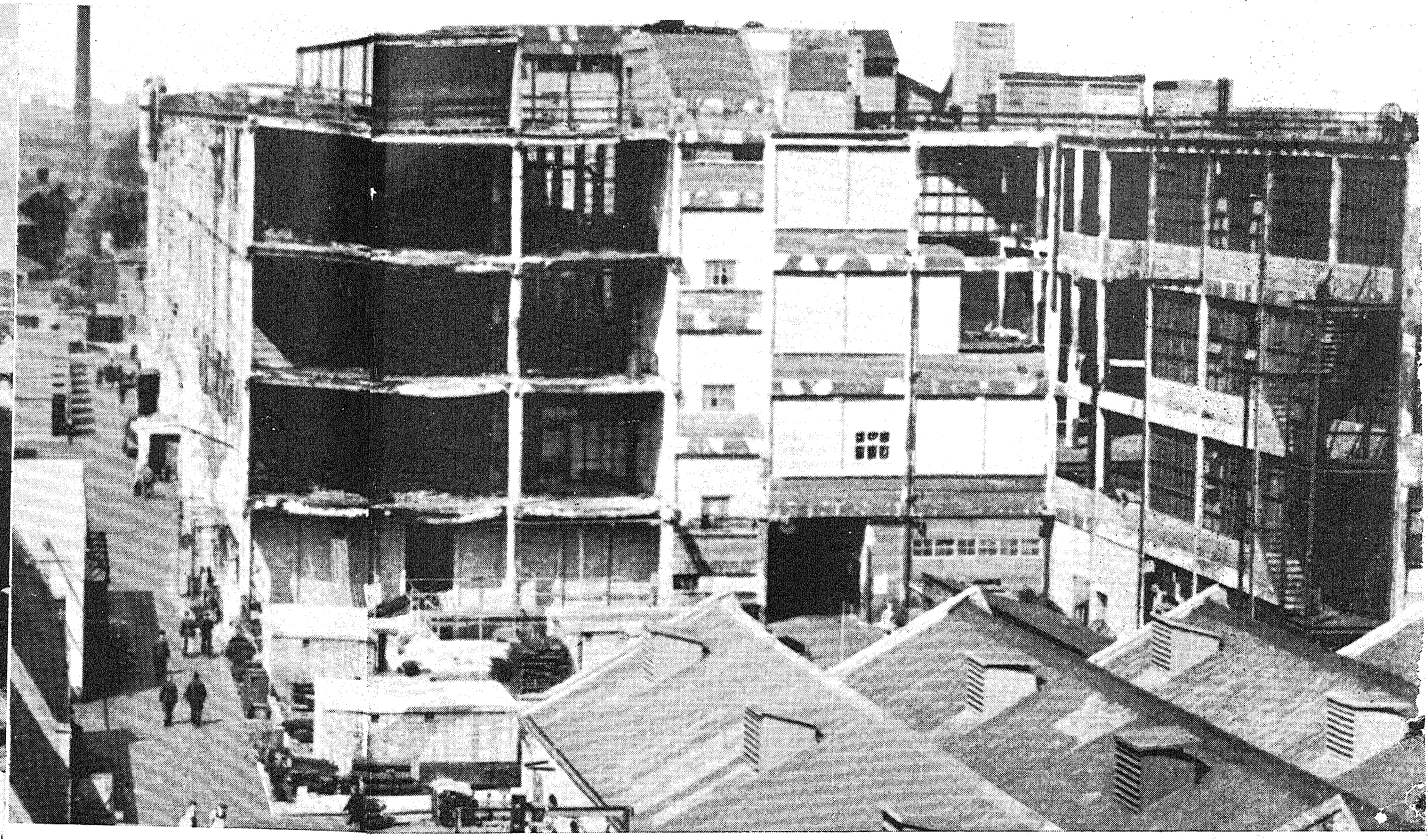
evacuate 500 from a basement shelter to others some distance from the company's premises. They were told of the decision and the reason for it; they would be conducted in batches of fifty at a time and there must be no torches and no smoking. To the thunder of the barrage and frequent showers of incendiaries the workers moved off in double file, the women going first. Not a hitch occurred. It was a fine example of the discipline and spirit of B.S.A. Small Heath.

The work of the first aid men and women that night was magnificent. Hour after hour they tended the victims before their removal to their homes or to hospitals. The surgery was like a front line casualty clearing station, the only difference being that the patients were not in uniform. And the work did not end that night. There were long queues of anxious relatives to be seen and in the first 24 hours nearly 200 inquiries about missing workers were received. In addition for the next six weeks the Surgery Staff worked tirelessly with the demolition squads, seeking and identifying bodies which could not be recovered until the mountains of debris had been cleared.

It was in this raid that the Luftwaffe adopted a new weapon. In various parts of the works' area a number of incendiary bombs were found to have almost buried themselves in the ground, only five or six inches of their tail fins remaining in view. These bombs were dug out with spades by A.R.P. men who would not have been so nonchalant in their task, perhaps, had they known that they were explosive incendiaries. It was the first time they had been dropped in the Birmingham area. Early in the raid two had actually penetrated the roof of a building and had injured two workers. But at that time they were not identified for what they were.

Three nights later the Luftwaffe again struck at the B.S.A. plant. If Tuesday night's raid had been outstanding, it seemed as if this time the whole establishment would be



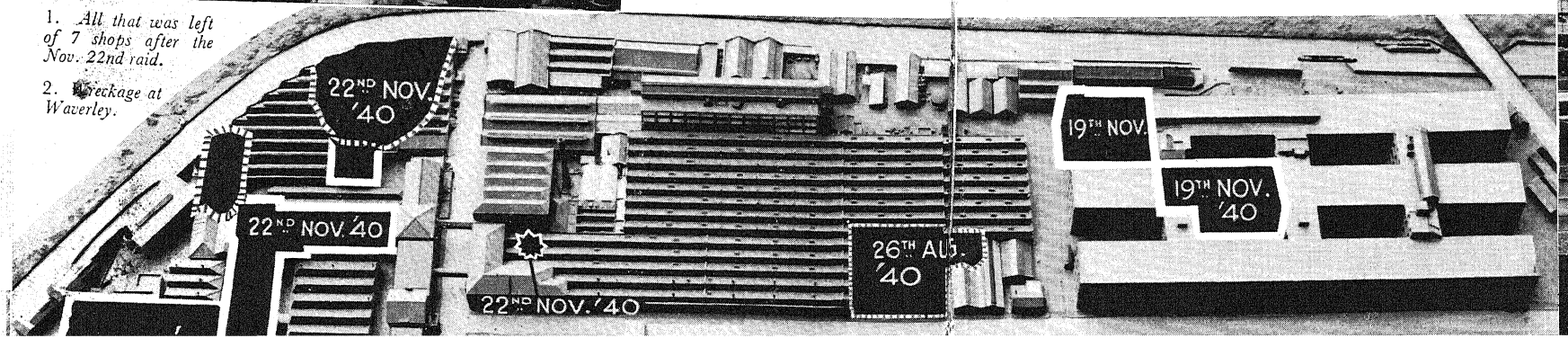


The scene of the disaster on night of November 19, 1940, when German bombers registered direct hits on the New Building at Small Heat causing the deaths of more than 0 employees and destroying an enormous quantity of plant. The photograph above gives an impression of t damage to the canal block, the end which was completely demolished in t fire which followed the bombing.

Below, the damaged section of the centr block bombed at the same time.

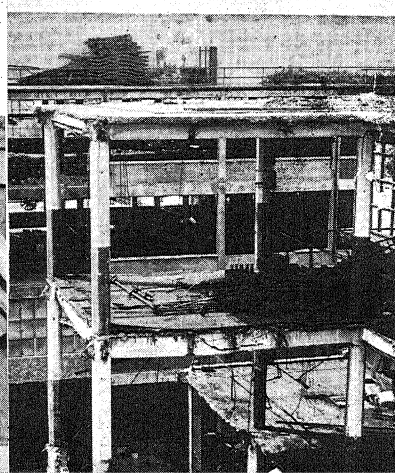
B.S.A. Blitz Damage

The B.S.A. Small Heath and Redditch factories were considered targets of such major importance that they were specially marked as such on the maps supplied to Luftwaffe pilots. Redditch escaped but Small Heath was subjected to a number of attacks in which grave damage was inflicted. The raids were:—August 26, 1940—Small Heath. Barrel mill and 7 shops destroyed, 4 others severely damaged. October 24, 1940—Sparkbrook. Extensive damage to Radix works in Montgomery Street. November 19, 1940—Small Heath. Hits on New Building destroyed 10 shop bays and severely damaged others. November 22, 1940—Small Heath. 7 shops destroyed, 2 others severely damaged. April, 1941—Small Heath. Land mine severely damaged boiler plant.



1. *All that was left of 7 shops after the Nov. 22nd raid.*

2. *Wreckage at Waverley.*



destroyed. It was obvious that the enemy pilots were well aware of the exact position and had again identified the works. Soon several big fires were raging. In addition, roof spotters could see that a B.S.A. dispersal factory at Tyseley and the B.S.A. Waverley works on the opposite side of the railway were both on fire after having received direct hits from high explosives.

So grim was the outlook at Small Heath that an order was given for the complete evacuation of the plant, only the fire fighters and A.R.P. personnel remaining. As on the previous Tuesday, there was complete calm and discipline among the workers as they were conducted from the Small Heath shelters to others some distance away.

By midnight the level of water was beginning to get dangerously low in the canal, the banks of which had burst at one point where a bomb had fallen, but fortunately supplies held out until all danger of the fires spreading had passed.

For some extraordinary reason the Luftwaffe was using a high proportion of delayed action bombs and this fact was one of the chief reasons for the enemy's failure that night to finish Small Heath as an arms centre for the rest of the war.

At a very early stage in the raid both the internal and external telephone systems were put out of action. Additional fire fighting squads were needed and Private William Saragine of the Home Guard volunteered to round them up on a motor cycle, although he had not ridden one for some years. Three times he was blown from his machine by bomb blast. On one occasion he found the motor cycle 40 yards from the spot where he had been thrown off. On another he ran into overhead tramwires which had been blown into the road. They were still "live" and it was only his rubber boots and the tyres of the motor cycle that saved him from electrocution.

In all Saragine rode between 50 and 60 miles, sometimes dodging round delayed action bombs to save time, sometimes crashing into debris flung across the road, but always carrying on.

No account of the raids would be complete without a special tribute to the roof spotters who throughout displayed a calmness, courage and devotion to duty of the highest order. However great the peril they remained at their posts until they either became untenable or orders were received to withdraw. The danger to which they were exposed can be gathered from the fact that before the end of 1940 two of the original posts were no longer usable, the buildings on which they were installed having had direct hits. From one of these posts the spotters, one with a withered arm, had to escape down a rope to safety. Night after night they carried on exposed often to biting winds, snow and frosts. They did not confine their attention to the B.S.A works. From their posts they were able to see over the entire neighbourhood and were often instrumental in preventing fires breaking out by warning the outside authorities of danger from incendiaries which had not been quelled by local firewatchers.

The raids had proved the basic soundness of the A.R.P. organization as planned before the war, but naturally certain modifications were needed. Experience had shown that evacuation to shelters some distance from certain shops was too long and too difficult an operation and new shelters were built to enable everyone to be under cover within a maximum of 60 seconds of evacuation being ordered; subsidiary canteens were built to serve both shelters and those shops which had to continue working when others had ceased; where necessary and practicable shops were divided by blast walls; certain vital plant was specially protected. As an alternative to the canal as a source of water

supply, three tanks were built in various parts of the works with an aggregate capacity of 120,000 gallons.

In the raid on November 22, hundreds of drawings were destroyed by a direct hit on the planning office. From that time until the end of the war all drawings were collected every night and taken by van to a safe place outside the city and brought back in the morning. As an additional precaution all master drawings and documents were photographed at a dispersal unit so that they could be reproduced, if necessary, with a minimum of delay.

* * *

There was death—and glory—at Small Heath that week in November, 1940.

Although there were no serious casualties in the second raid, 53 employees, whose names appear below, were killed in the first attack, in which also 89 people were injured, 30 of them seriously. Nearly all the casualties occurred in the New Building from which the last body was not recovered until six weeks after the raid.

Roll of Honour

B.S.A. employees killed in enemy bombing raids on factories 1939–1945

Ball, Joan
Bartlett, Leslie
Beach, Elizabeth
Beet, Robert
Broome, John
Bruce, Andrew J.
Bryan, Albert E
Dale, Constance
Davies, George R.
Davies, Stanley
Dowse, Sarah E
Dowse, T.
Duggan, Robert
Edge, Margery
Foulston, Roy
Hackett, H. R.
Hall, Harry
Hemms, William
Hill, Charles E
Hind, Albert
Holdaway, Arthur
Horne, Harold
James, William H
Kirk, Alfred
Lovesey, Arthur
Marklew, William
Mason, J.
Metcalf, Matthew
Minor, William
Mitchell, Frank
Morgan, John W.
Mucklow, Joseph
Mugleston, Stanley
Osmond, Florence
Parker, Joseph
Parr, Gwendoline
Partridge, Phoebe
Payne, Edgar
Phillips, Albert E.
Poolton, George
Pratt, Herbert
Price, Thomas W.
Reacord, Charles
Robinson, Kenneth
Rudge, Albert A.
Scragg, Alfred
Skinner, Leonard
Sumner, J. W.
Truman, Evelyn
Tucker, Ernest E
Ward, Spencer L.
Williams, David
Woodley, Jack

The heroism of B.S A. employees during the raids was acknowledged by the following awards:

GEORGE MEDAL

Private Albert Bailey, Home Guard
Alfred F. Stevens

BRITISH EMPIRE MEDAL

Corporal John H Beattie, Home Guard
Alfred W Goodwin
Arthur R E Harris
Private William Saragine, Home Guard
Albert Slim
Sergeant Joseph Topham, Home Guard

M B E

Miss Ada Deeming, Matron

COMMENDED

Samuel S Ashburner
Edwyn Hoof.
Private Frank Knight, Home Guard
Private George Treem, Home Guard
Ernest Williams

Small Heath had now been subjected to three vicious raids. The accumulated damage in machinery and machine tools was colossal, while no less than 4½ acres of floor space, out of a total of 32 acres, had been destroyed and another half acre severely damaged.

It is difficult to understand why the Luftwaffe did not return after the November raids since three or four such attacks would undoubtedly have wiped out Small Heath. The most tenable theory is that the enemy, through the failure of his Intelligence Service, did not learn for some considerable time the real extent of the damage at the B.S A works. And by then it was too late to inflict irreparable damage for further dispersal had taken place and there was always an alternative source of supply of all weapons.

There is an epilogue to the Small Heath blitz. The King, who, with the Queen, had inspected the B. S. A. works in the previous April, decided to pay a second visit to Small Heath to view the damage

◆ *The King and Queen at the B S A works at Small Heath in April 1940 With her Majesty is Mr James Leek*

A few days before his visit it had been reported by roof spotters that a delayed action bomb had fallen within the company's premises. Every inch of the ground was examined but no trace of a bomb could be found; it was, therefore, presumed to have fallen some distance away on the other side of the canal. The King duly arrived and spent some hours touring the entire plant, during which he watched the work of salvaging machinery from the New Building and the search in the debris for the bodies of still-buried victims. Less than 24 hours after his departure, the entire works was shaken by a heavy explosion and the heavens began to rain lumps of coal. The bomb had buried itself in a dump and the displaced coal had fallen back into the hole it had made, thus leaving no tell-tale crater to guide the Home Guard searchers. And during his tour the King had stood very near this particular spot.

CHAPTER X

THE FINEST HOUR

SO through a November ordeal of fire and bomb the Birmingham Small Arms Company came to its finest hour. It was an hour in which the minutes ticked on into days, into nights, into weeks. It was the hour in which men fought to re-enter the Battle of Production. And in the end they triumphed.

While the Tuesday night raid was still in progress, the fact that B.S.A.'s largest building had received direct hits was reported to Lord Beaverbrook, then Minister of Aircraft Production. But he did not know the extent of the damage, and at a very early hour—shortly after dawn in fact—he was telephoning for information. Four times that day he telephoned, such was the anxiety of the members of the War Cabinet. Their chief concern was the Browning gun. Only too well did they remember that only a few weeks before in the Battle of Britain, R.A.F. lorries and tenders had been lined up day and night outside the Browning shops waiting to rush small batches of finished guns direct to the fighter airfields; they knew too that Spitfires and Hurricanes in the latter stages of the battle had, on occasion, climbed to meet the Luftwaffe with only six or even four guns in place of their normal eight.

Each time Lord Beaverbrook telephoned James Leek assured him that deliveries would continue. But it was not until he was answering the fourth call of the day that he was able to iterate his assurance with any real conviction in his heart that there would be more than token deliveries. He had seen the New Building hit, and at first, with flames

belching from the bombed ruins, it had seemed that the whole structure where lay the heart of Browning Gun production, was doomed.

But if in the dawn the works presented a sombre scene, it at least brought one ray of hope—the fire had been prevented from spreading to the rest of the New Building. Gradually Leek was able to assess the position.

First, certain Browning shops at Small Heath were still intact and would be working again as soon as the necessary power and water supplies were restored. (Even then a day and night shift could—and did—continue to operate in certain parts of the works).

Secondly, it might be possible to salvage from the New Building a proportion of the machine tools lying in the ruins—and machine tools at that time were more precious than any gold.

Thirdly, he had two other shops working on Browning components outside Small Heath. In the previous May, 50,000 square feet of floor space had been taken in a factory at Smethwick, while in the July, machines had been installed in a 30,000 square foot shop at Tyseley. These moves were, in reality, dictated by the need of expansion to meet the ever increasing demand as much as by the necessity of dispersal. But dispersal or expansion, the vital thing was that they were in production.

Fourthly, there was a still considerable quantity of finished parts in the Small Heath assembly departments. A proportion of these, however, was for the moment useless since there was not a sufficient number of complicated components, such as the breech block, to enable them to be made into finished guns.

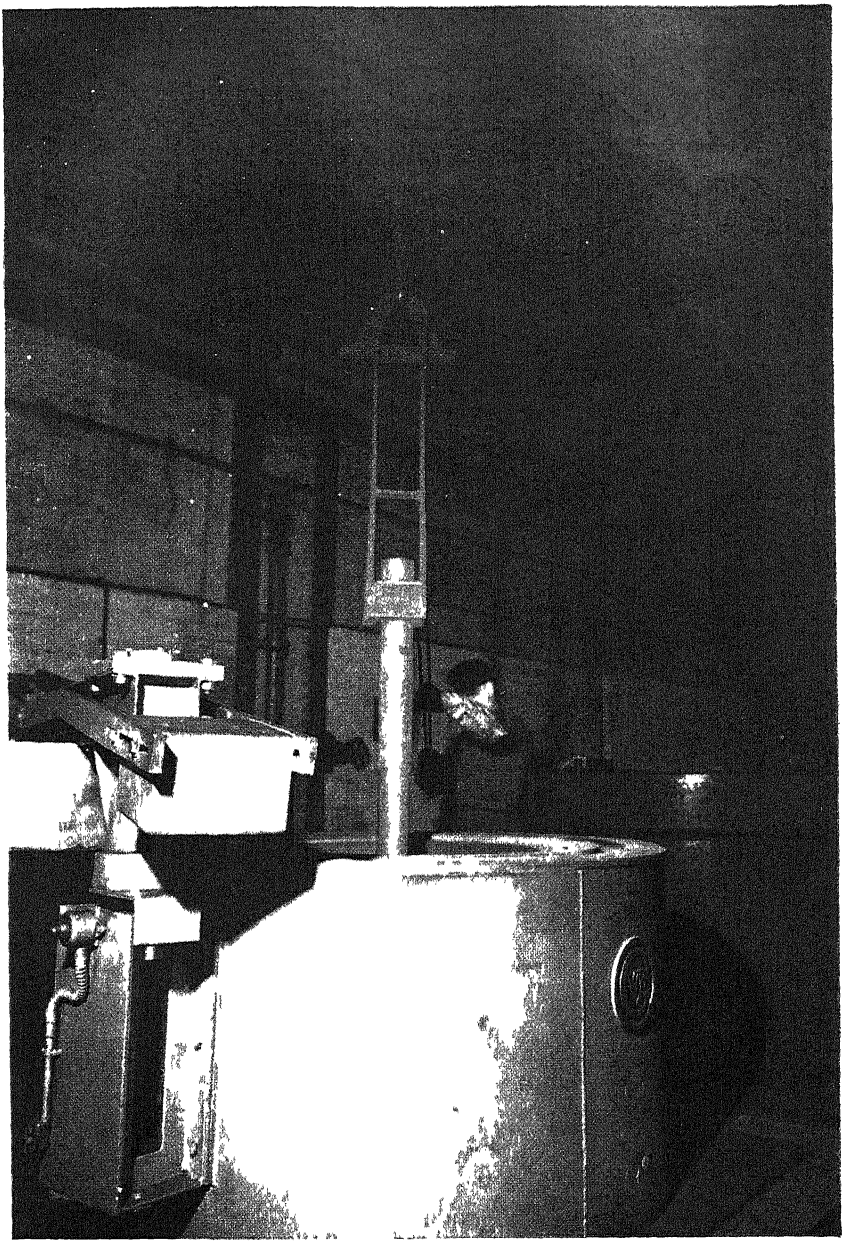
This then was the situation, and immediate decisions were taken to meet it. The two chief considerations were

to get the Browning Gun into the fullest possible production again at Small Heath with the minimum of delay and to establish new machine shops at once in all parts of the Midlands so that never again could the bombing of a single factory seriously endanger output. It was to be dispersal—and at the same time expansion—on a grand scale.

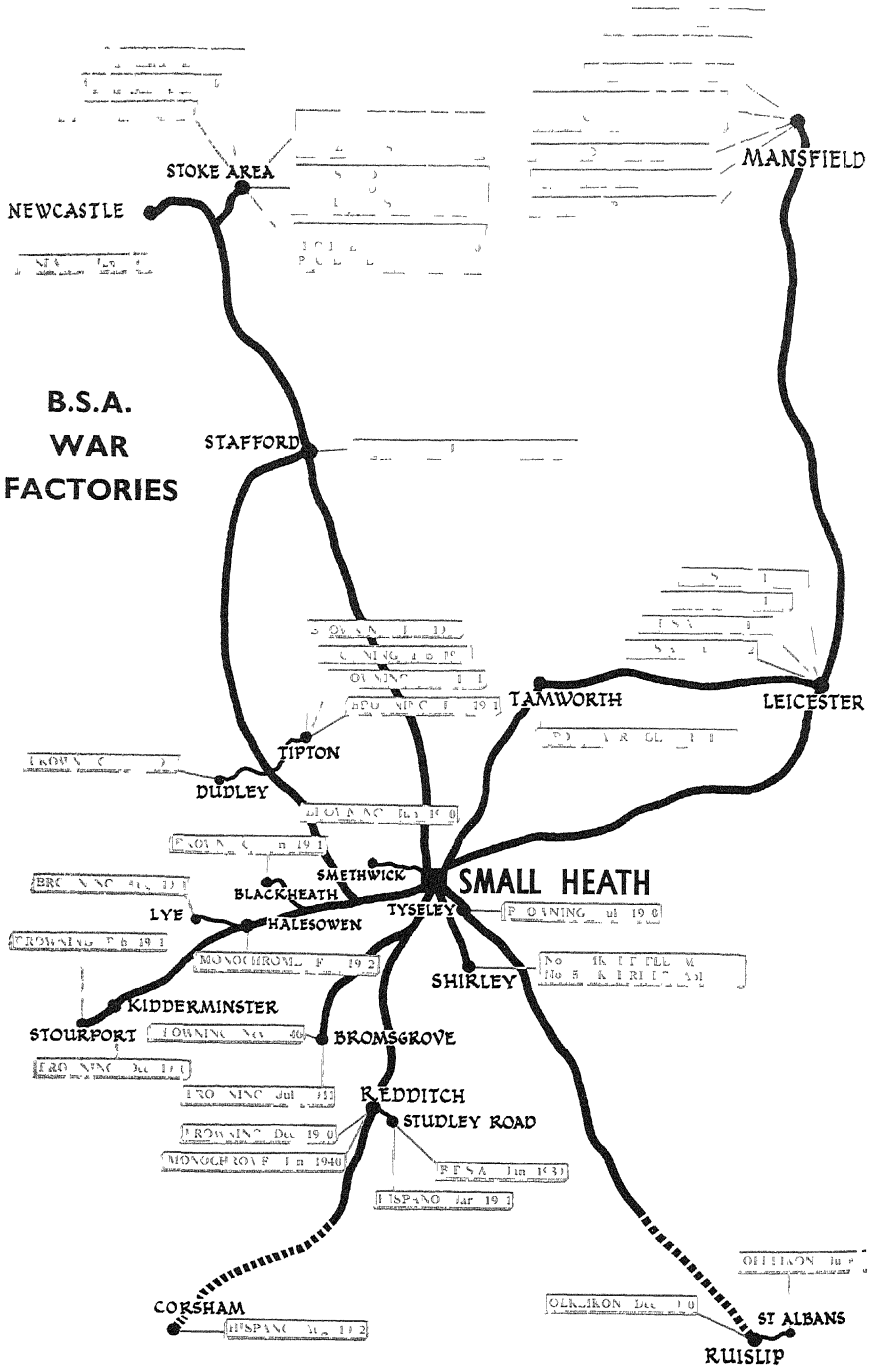
As soon as the debris at the New Building had cooled sufficiently to enable operations to start, squads of millwrights with block and tackle began the task of salvaging the machine tools. As each one was retrieved—some had to be dragged from dangerous positions on the third floor—it was examined and either condemned as scrap or loaded on a lorry to be taken to repair works. Some were found that could be made serviceable again by the company's own toolroom men but such machines were all too few. Side by side with the millwrights other squads of skilled men started to sort and identify thousands of tools and gauges as they were recovered.

While this work was proceeding at Small Heath, officials of the company were sent forth north, south, east and west throughout the Midlands to discover suitable new homes, not only for the Browning Gun but for other vital weapons affected by the blitz—the Boys anti-tank rifle and the two-pounder gun carriage, both in urgent demand in Libya; Bren components, which had been housed at the destroyed Radix Works; the Rocket Projectile and the No. 117 and No. 700 fuses.

On that Wednesday there was not the same hope in the workers' minds as there was in that of the management—that there would be work for all of them again soon at Small Heath. By 10 a.m. there was a queue of many hundreds outside the employment department waiting for their insurance and unemployment cards. (This was before the



◆ *The vertical furnaces, originated by B S A technicians, to eliminate the setting up of stresses in gun barrels during tempering processes*


B.S.A.
WAR
FACTORIES
STOKE AREA
NEWCASTLE
MANSFIELD
STAFFORD
TAMWORTH
LEICESTER
TIPTON
DUDLEY
SMETHWICK
BLACKHEATH
SMALL HEATH
LYE
TYSELEY
HALESOWEN
SHIRLEY
KIDDERMINSTER
STOURPORT
BROMSGROVE
REDDITCH
STUDLEY ROAD
CORSHAM
ST ALBANS
RUISLIP

Essential Works Order prevented a man or woman leaving employment without permission). But these employees were too valuable to lose; they had been trained in B.S.A. ways and would be needed far sooner than they expected. A consultation was held with the Ministry of Labour, at which it was agreed that, while workers would be given their cards on demand, they would only take up other employment "on loan" and would be returned to the company when required.

Then came the Friday night attack. If the position had seemed grim in the light of the Wednesday dawn, on the Saturday morning it seemed well nigh hopeless with the new damage. No workers could be admitted to the premises since production could not continue even in the remaining undamaged shops because of the disruption of the essential services. Employees congregated in large crowds at the entrance gates.

The task of maintaining Browning Gun deliveries was now desperate indeed. Between November 1 and 19, 3,800 guns had been dispatched from Small Heath and the month's output had seemed likely to top the previous record of 5,500 in July (spares had then been used to make up complete guns so great was the need for them after Dunkirk).

But even on the Saturday morning James Leek did not despair. He had one card which *might* prove a trump. At the outbreak of war B.S.A. had been charged by the Ministry of Aircraft Production with the initiation and management of a vast scheme for the production of Browning Guns by sub-contractors. All details had been left to the company, which cleared a section of its new Redditch factory for assembly of the weapons. Deliveries from this source had started in the previous June with just over 250 guns.

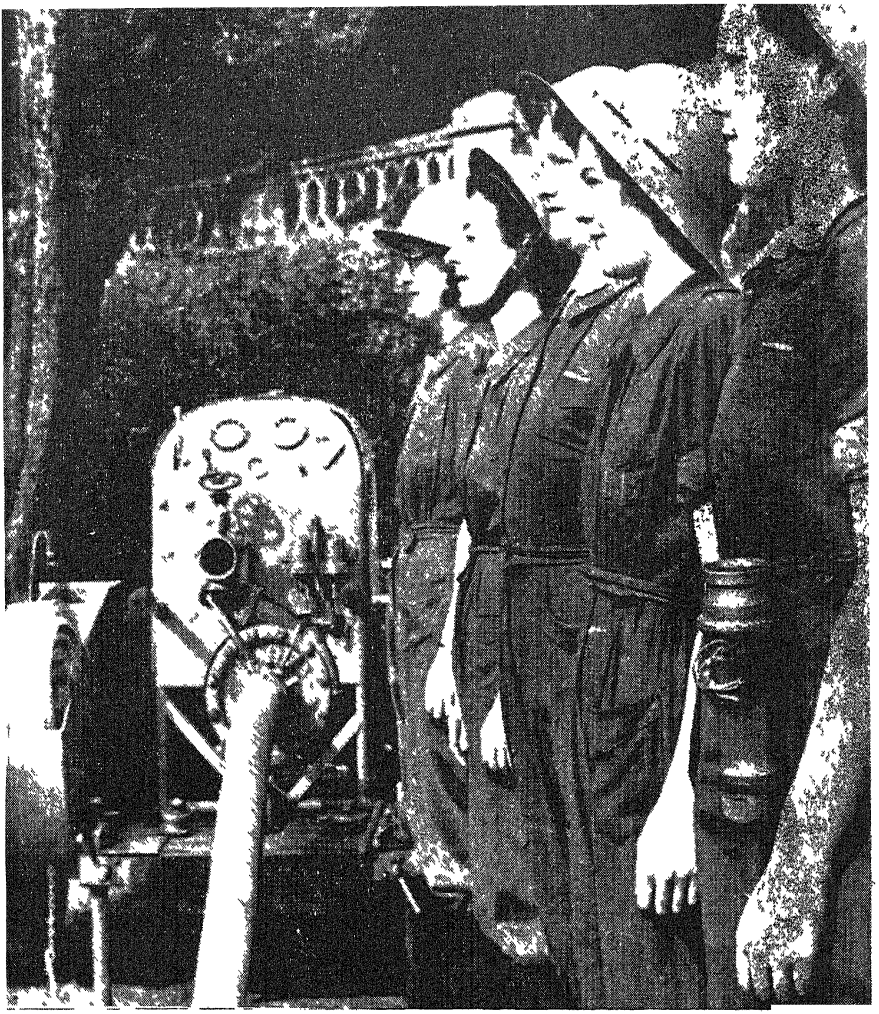
Mr Leek sent for the man he had put in charge of the scheme. There was scarcely any need for words. There was just one question: "How many can you deliver?"

Although output had been steadily rising, deliveries had been increased in the last six or seven weeks only by using spares to maintain supplies to the Battle of Britain fighter squadrons. These stocks of spares were now nearly exhausted and the December deliveries were expected to show a substantial drop. Despite this the man in charge of the scheme named a figure for deliveries in the immediate weeks far in excess of what he could normally have hoped to produce. And what was more he promised to supply a batch of 350 guns at once. The situation was saved.

Here it must be stated that although fewer than 900 Brownings were delivered from Small Heath and the dispersal factories in December, the R.A.F. received in all 2,472 B.S.A. guns in the month, the rest having been supplied by the sub-contracting scheme. This production achievement was materially assisted by loaning to the sub-contractors some of the highly skilled Small Heath personnel, who by reason of the blitz would otherwise have been temporarily unemployed.

Meanwhile as the salvage gangs continued to labour at their task throughout that black week-end, a task made doubly heavy by the additional damage of the Friday night's bombing, reports began to arrive from the officials who had been sent to find new premises for the production of the various weapons.

With one or two exceptions, their reception by factory owners still engaged on civilian production had not at first been encouraging. Few of them seemed to realize, even at that stage of the war, the desperate plight of the country. But if the factory owners did not realize it, the Small Heath



◆ *READY FOR THE LUFTWAFFE—Girl workers at dispersal unit formed a complete fire-fighting squad*

officials certainly did. Each of them had been given a copy of a letter sent to the company authorizing B.S.A. to take possession of whatever premises it needed. Armed with this letter, pending a formal requisitioning notice, they were able to secure such shop space as was immediately necessary.

In one case it was not only the owner who offered opposition, but a whole trade association. This was in Stoke-on-Trent, where after a day's search, three suitable factories were found. The B.S.A. official was returning with the local requisitioning officer to the latter's office when a messenger intercepted them in the street and asked them whether they would go at once to see the Lord Mayor. They agreed, and arrived at the Town Hall to find that with him were the President and Secretary of the Potteries Association. A furious argument ensued over one of the factories which it was proposed to requisition. Finally the B.S.A. official agreed to waive his claim if the Ministry of Food could be induced to give up another and equally suitable building which was being used as a sugar store.

Within three hours of a verbal message being received from London that the Ministry was willing to give up the building, an official of the Company was on his way from Small Heath with an 8-ton van and 20 men to shift the sugar to a local dance hall. Following was the first lorry load of equipment.

The official knew that there might be trouble since the order permitting the removal of the sugar had not yet arrived. But he had a plan of campaign. While he himself went in to see the manager of the factory, his men began the removal. The factory foreman, realizing what was happening, hastened to tell his chief but committed the unpardonable error of not first knocking on the door. He was promptly told to wait outside until called. But when eventually he received the summons it was too late—the first load of sugar had left. Now that one load had gone, the manager agreed with a helpless shrug of his shoulders that the rest might as well be shifted. Thus did B.S.A. enter into possession.

Before the end of November eight factories or parts of factories had been requisitioned, six for Browning Guns and two for fuse production. In the following month premises for two more Browning Gun dispersal units were taken over, together with two more for fuses and one each for the manufacture of Bren components and rocket projectiles. Altogether more than 400 factories were inspected in connection with the dispersal.

Some idea of the vast organization eventually built up by B.S.A. can be gathered from the chart facing page 65 which shows the factories or factory spaces which, at the peak of production, it was managing

With the requisitioning of premises the next chapter in the story of the great dispersal began. It was the supreme test of B.S.A. training and tradition, and the hour produced the men to manage and staff the units, men who had never before shouldered great responsibility. Overnight fitters became foremen, foremen became managers, and section managers became superintendents of the dispersal units. Out they went with their first lorry-loads of machine tools and equipment and a nucleus of skilled men to help them. Small Heath would plan and supervise and help them all it could but the main responsibility lay with the men themselves. They had one paramount instruction: "Get into production". Their task was stupendous and it was made all the more difficult by the bitter conditions of that winter. Snow frequently blocked the roads; often the premises they took over were without heating. If they were lucky they managed to obtain coke braziers. There were no canteens to give them hot meals. In some areas it was impossible at first to find sleeping accommodation. They worked from

morn till night and, when too exhausted to continue, they slept in their clothes in the shops, only to start again a few hours later. That they would succeed was only expected of them—they were men picked for the job. That they would triumph in the manner in which they did was even beyond the most sanguine hopes of the directors.

To Bromsgrove went the distinction of being the first of the Browning Gun dispersal units to start production after the Small Heath blitz. The works consisted of two adjacent premises, one a shoe and glove factory, which was so packed with machinery and stock that it was difficult to move about, and the other a wood-working shop filled with saws and wood-cutting machinery. Once requisitioned not a moment was lost. The first lorry-load of machine tools arrived on the afternoon of Tuesday, November 26, and from that minute it was a case of the Browning gun equipment being moved in at the front as the glove, shoe and wood-working machinery went out at the back. Permission had been given for a glove order to be completed and at one time millwrights were standing round three machines on which the girls were working. As each finished her job, her machine was disconnected and trundled out.

On Saturday, November 30, some 30 machines were started. The first Browning gun dispersal unit was in production.

Most of the employees had at first to be brought from Small Heath and transport threatened to be a serious problem. The urgency, however, was too great to allow red tape to stand in the way and the R.A.F. provided a tender on which day after day as many as 60 people crowded. Within three weeks every department was working and in

five weeks the plant was in full production. Here there was no labour problem as each one of the displaced boot and shoe operatives, already accustomed to machinery, was absorbed by B.S.A.

At Kidderminster, part of the premises of a carpet factory had been requisitioned and the section B.S.A. was to occupy was packed with 3-ton looms. Assisting in every possible way, the owners lent the company men to dismantle the machinery and to aid a party of millwrights from Small Heath to remove and pack it. In addition to the looms, 60 tons of wool of various colours had to be packed and stored. Again the factory owners came to the rescue and detailed an expert colour hand to supervise the work, which took several days to accomplish. Here, as in the case of Bromsgrove, B.S.A. machines were going in as the looms went out. And amid the apparent confusion, electricians were steadily working to put in power plugs so that as each machine was installed it could be started.

One of the most difficult dispersals initially was at a needle and fishing-tackle manufacturer's premises at Redditch. Machines had to be brought down a 1 in 4 slope, a complicated procedure at the best of times but made all the harder by reason of heavy snow. And even when this slope had been successfully negotiated the machinery had then to be taken into the shops through a hole in the main wall of the factory. The key men, fitters and millwrights from Small Heath, worked with such a will, however, that within a fortnight the manager was able to make the signal to Small Heath "first machines running."

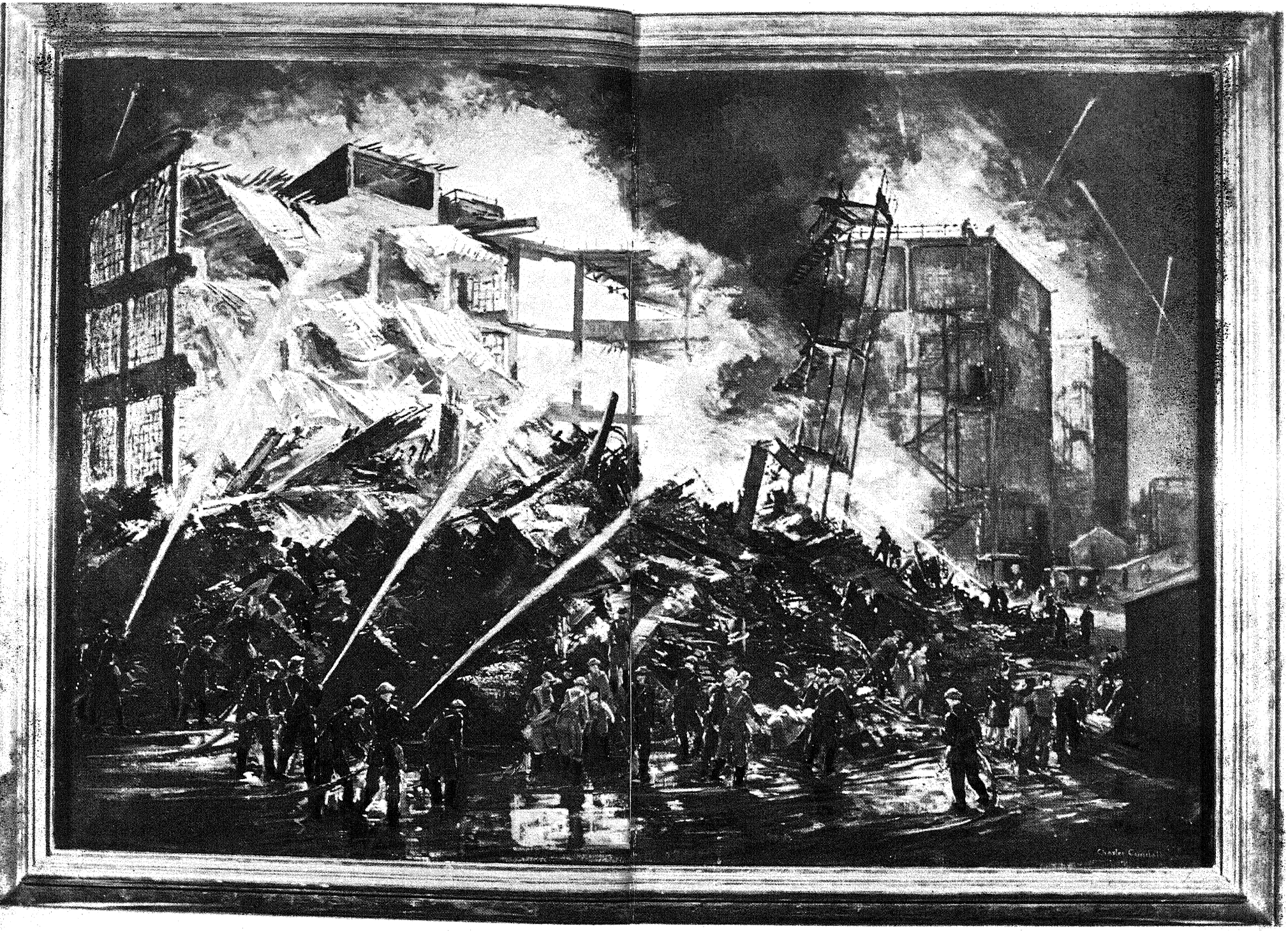
Had it not been for the Small Heath operators who formed themselves into volunteer labour squads, there would have been much greater delay in getting the dispersals into production for there was enough work for ten times the number of millwrights available from Small Heath.

The removal of the machinery to the works of a bedding manufacturer at Tipton was accomplished almost entirely by operators, sometimes with a millwright to advise them but more often on their own. While some pulled and slid machine tools over the bomb-damaged floors and corridors of Small Heath and loaded them on waiting lorries, others were at Tipton clearing hundreds of tons of sheet metal from the factory, which had been used as a store. And when the machinery arrived most of it was installed by the operators. Here small quantities of minor components were being produced in a fortnight, while before the end of January, 1941, production of almost all the parts the section had been manufacturing at Small Heath had recommenced.

Conditions at the start, however, were very bad. For the first two or three months everyone worked in overcoats, for there was no system of heating, and before one could be installed the building structure had to be strengthened.

Existence was equally uncomfortable for a time at Stafford, where the equipment for making anti-aircraft rocket projectiles had been installed in part of a reinforced concrete works. There was no internal heating in the factory area, which was very lofty, and it was only with misgivings that the local company laid on a supply of gas—it was explained that it could scarcely cope with the town's existing requirements and there was a danger, when the B.S.A. plant was in production, that it would cause chaos in the immediate neighbourhood. The gas company's fears were well founded, for on the first day on which the factory began to operate fully all residents in the surrounding area found the pressure on their gas fires and cookers reduced by half. This problem was soon overcome, however, by the installation of gas producer plant.

The shortage of Browning Gun breech blocks, the most difficult component of all to make, involving, as it did, some



◆ *This picture, painted by Charles Cundall, R.A., for the Birmingham Small Arms Company, depicts the scene at Small Heath on the night of November 19, 1940, when German raiders registered direct hits on the New Building, centre of Browning gun production.*

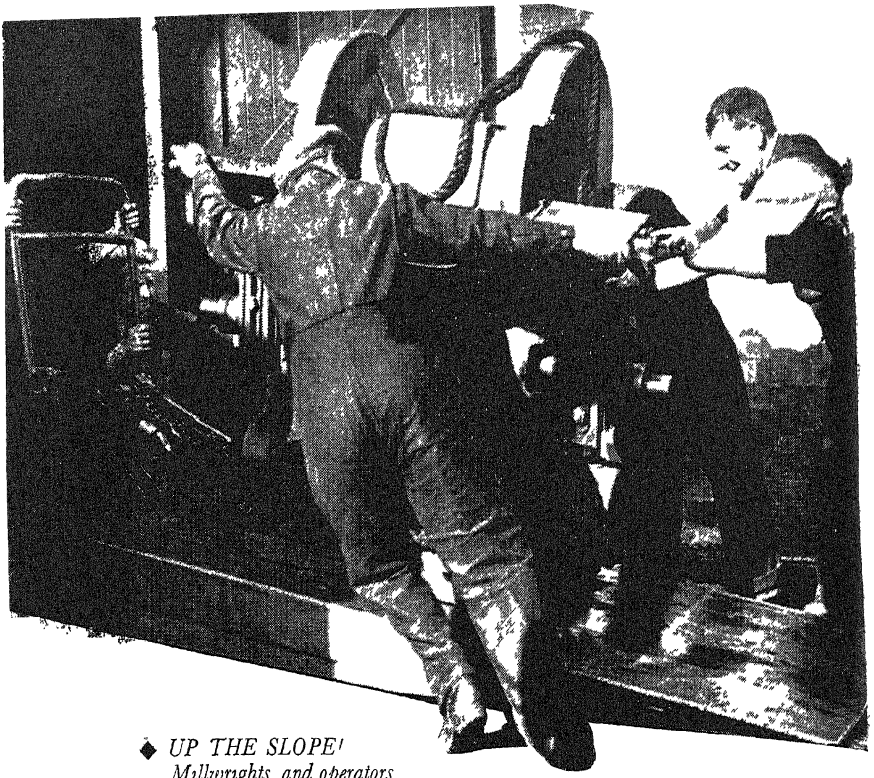
150 operations, was felt most acutely in the first few weeks after the blitz So great was the need for them, in fact, that special salvage squads were given the task of searching the New Building debris. They were recovered from the rubble in ones and twos; some had been distorted by the fire beyond all repair but others were reconditioned after hours of patient bench work. Some were found undamaged but these were few and far between.

The search for parts was not confined to the New Building ruins An official of the company conceived the idea that large numbers might be recovered from dumps of crashed R.A.F. aircraft. Lorry-loads of scrapped guns, many of them with twisted barrels, began to arrive at Small Heath within a few days and proved an invaluable source of components during the crisis.

Many of the tools lost in the raids could have been replaced at once from the stock of a Birmingham manufacturer, but his premises had been burned out together with all his records. It was not an infrequent sight to see a B.S.A. fitter from one of the dispersals turning over thousands of salvaged tools in an attempt to discover the type he needed.

With the resumption of Browning gun production well in hand, attention was turned to the Boys anti-tank rifle. In January, parts of two factories were requisitioned in Mansfield (a third was taken over in the following month and a fourth in April).

The arrival of B.S.A. in a town which had never heard the explosion of a bomb, still less experienced a raid, was very mixed. The townsfolk, who could naturally do nothing to prevent the establishment of armament works in their midst, were fearful lest the Luftwaffe follow B.S.A. from Birmingham to Mansfield. There was serious opposition by the owners of one factory to clearing their premises



◆ *UP THE SLOPE!*
Millwrights and operators man-handle machinery into a dispersal factory after the Small Heath blitz

although they had been requisitioned. It was only when threatened with legal proceedings by a representative of the Ministry of Supply that their obstructionist tactics collapsed. But when help and co-operation was given, it was forthcoming to the full. A difficult problem arose at another factory in which the second and third floors had been taken. All the machines had to be lifted through a hole 10 feet by 9 feet, but there was no tackle to do the job and none could be obtained quickly. An engineer engaged on oil boring in the neighbourhood volunteered to help and within 12 hours produced a tractor complete with cable, pulley, blocks, and workmen. Not content with this assistance, he insisted on superintending the actual lifting,

climbing on some girders 70 feet above the ground to sling the pulley blocks. And he remained there until all the machines had been hauled up

To install machines at another factory in the area it was found that grillage would have to be put over the entire shop. When efforts to find necessary labour proved unavailing an appeal was made to the authorities and a company of the Pioneer Corps was at once detailed for the work, the men being brought daily by lorry from Long Eaton, 20 miles away.

Although a great number of machines was quickly installed in the various requisitioned shops, there was still a great deal to do before production could be started. Much of the machinery had been damaged in the blitz at Small Heath and every available repair works in the Mansfield area was busy for weeks on the task of reconditioning them or making new parts. In addition, numbers of machines which had escaped damage in the raids had been loaned to the Browning gun dispersal units in view of greater priority on the production of the latter weapon and this involved a long wait for the necessary replacements.

As the dispersal units were started in ones and twos, men and women who already knew the work were urgently required. The addresses of those who had demanded their cards after the Small Heath blitz were obtained from the Ministry of Labour and messengers on cycles and motor cycles were sent round to tell them to report at once. Some of them were needed in the factories near Birmingham and these were transported backwards and forwards every day until most of them found lodgings in the neighbourhood of their work. Others were wanted in factories too remote for daily travel. Those willing to go to form a nucleus of skilled labour to help newcomers to the machines were

given their railway fares and told to report as soon as possible to the factory manager. There were many tussles with the Ministry of Labour officials over the return of employees who were settling down on other priority work, but in nearly every case the company eventually succeeded in recovering the workers it needed, although in some cases it took several months.

A word must be said here about the aid provided by local authorities as regards the billeting of the men. Without their help the difficulties could not have been overcome. Many managers first canvassed districts themselves but, being strangers, obtained little success. When, however, the billeting officer himself took a hand, vacant rooms appeared by the score in houses which had previously been full. In one instance a police superintendent, to whom an appeal was made, detailed a young constable for the job. Within 24 hours he had found sufficient billets for immediate requirements and by the end of the moving-in period had placed 150 workers in suitable accommodation.

Many of the dispersals had "set pieces" for the entertainment of service visitors. Two of the best were to be found at Lye, used as the dispersals' assembly centre for Browning guns. First there was a welder reputed to be the fastest worker in the whole organization. When a small crowd had gathered round to watch him using his oxy-acetylene apparatus, he would take from behind his ear a half-smoked cigarette (never a whole one) and with a quick sweep would light it by drawing the cutting flame under his nose. There was always a suitable shudder from the spectators, who realized that the slightest error would have involved a terrible burn. The man, however, would merely smile and tell them "This 'ere is a precision shop".

The other "show" was in the testing range where at a given signal the men firing the guns would "play" a tune,

"The Little Tin Soldiers", on their Browning guns, one of them joining in at the appropriate moment by "picking off" single shots on a weapon that was firing at the rate of 1,200 a minute! It had to be heard to be believed.

If the strain of the battle to resume production was felt at the dispersal units, it was felt fourfold at Small Heath, which was the nerve centre of the whole scheme. Everything had to be organized there—output of each unit planned, raw material ordered, machines and tools supplied where possible; even the wage packets made up and dispatched. And on top of this were all Small Heath's own problems of recommencing production in the wrecked and damaged shops. (Actually a day shift was started again at Small Heath in the week following the blitz, while within ten days a night shift was re-formed and continued to operate until the end of the war).

Figures, not words, best tell the story of the magnitude of this B.S.A. triumph. In December, 1940, the month's output of Browning guns at Small Heath and at the dispersals was 894 finished weapons, while the sub-contracting scheme contributed a further 1,578. By the following March the figures had risen to 3,750 and 3,860 respectively.

So did the R.A.F. get the guns again.

For their work at this and other periods of the war four of the company's staff were named in Honours Lists. James Leek was made a Companion of the Order of the British Empire, W. L. Rawson and A. Wood became Members of the same Order, while F. T. Whitehouse was awarded the British Empire Medal.

The story of the great dispersal would be incomplete without the directors and staff of the Birmingham Small Arms Company expressing their great appreciation of all the assistance and courtesies extended to them by officials

of the following companies, whose premises were taken over in whole or in part during the War:—

W. & R. R. Adam Ltd., Kidderminster; Armstrong Siddeley Motors Ltd., Birmingham; Asbestolene Ltd., Tamworth; Barringer Wallis & Manners Ltd., Sutton-in-Ashfield; T. & R. Boote Ltd., Tunstall, T. Bond Worth & Sons Ltd., Stourport; J. & A. Brazier Ltd., Bromsgrove; British Reinforced Concrete Engineering Co. Ltd, Stafford; The Co-operative Wholesale Society; G. K. Davies & Co. Ltd., Lye; Dobsons (Silk Throwsters) Ltd., Sutton-in-Ashfield; Victor Drury & Sons Ltd., Bromsgrove; Thomas Dudley Ltd., Dudley; Dudley Zoological Society; English Needle & Fishing Tackle Co. Ltd., Redditch; Firth Vickers Ltd., Blackheath, Birmingham; Harwood Cash & Co. Ltd., Mansfield; Hilcrete Ltd., Brocton; T. G. Hirst & Co. Ltd., Leicester; Wm. Hollins & Co. Ltd., Mansfield; H. Hope & Sons Ltd., Smethwick; G. Howson & Sons Ltd., Hanley; Illingworth & Co. Ltd., Sutton-in-Ashfield; H. & R. Johnson Ltd., Tunstall; Charles Lathe & Co. Ltd., Tipton; Mansfield Shoe Co. Ltd., Mansfield; Minton Hollins Ltd., Stoke-on-Trent; Paragon Crafts Ltd., Bromsgrove; Quortex Ltd., Mansfield; Rudkin Laundon & Co. Ltd., Leicester; Richards Tiles Ltd., Tunstall; Triplex Foundry Ltd., Tipton; Vono Ltd, Dudley Port; Wednesbury Tube Co. Ltd., Bilston; W. Whitehouse & Sons, Halesowen; and Wolsey Ltd, Leicester.

The following chapters deal with the principal weapons made by B.S.A. during the war. Each weapon has its own individual story but each story reveals one common factor—the grim determination of a people at war to battle on to victory.

CHAPTER XI

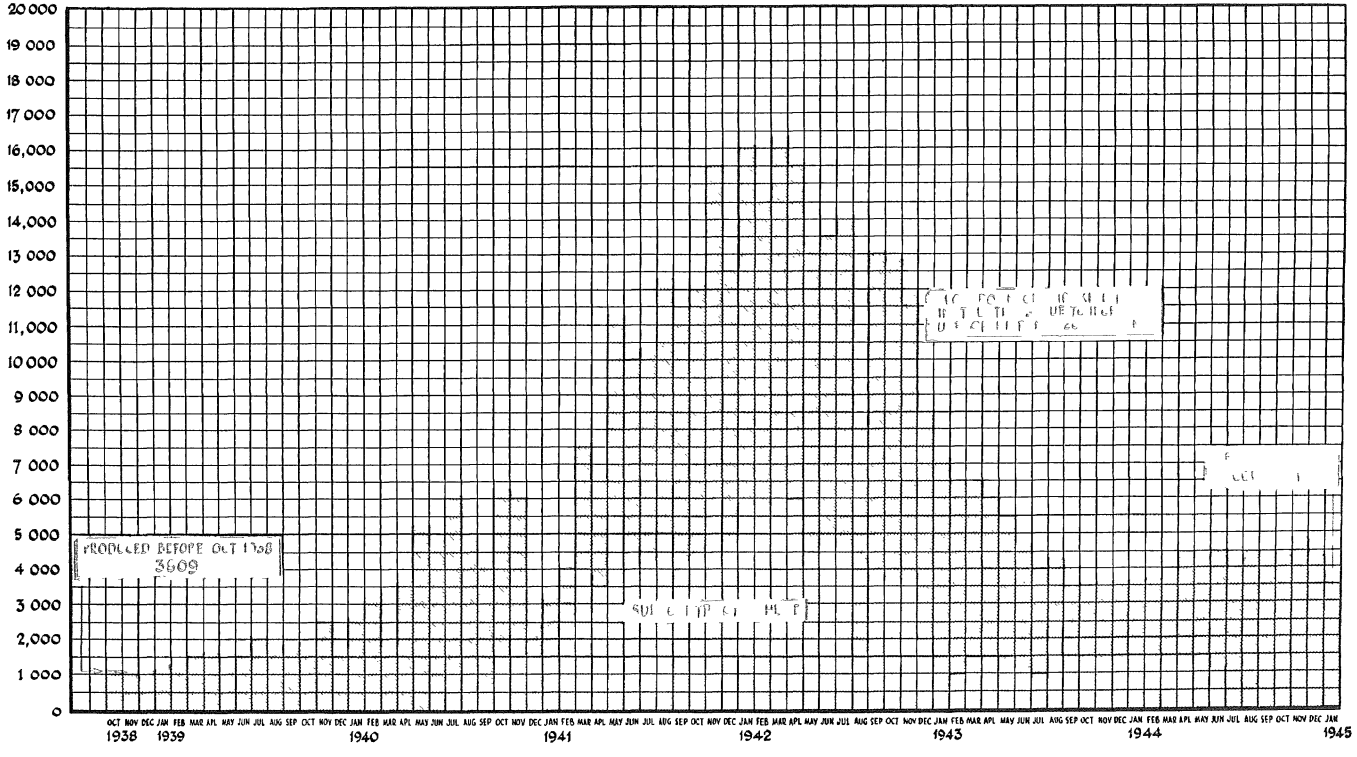
THE BROWNING MACHINE GUN

THE search for a new weapon with which to arm the Royal Air Force started in the early '30s as soon as the aircraft designers began to evolve military types from the planes which had won the Schneider Trophy outright for Britain. In 1931 an R A.F. pilot had exceeded a speed of 400 miles an hour in one of the trophy race aircraft and it was obviously necessary to equip the new fighters with an infinitely faster gun than the 450-rounds-a-minute Lewis gun which had done yeoman service in the 100-mile-an-hour fighters of 1917 and 1918. To find the ideal weapon there was held in 1934 at Martlesham Heath, the R.A.F. experimental station, a competition in which were entered five machine guns—the Colt, later to be renamed the Browning after its American inventor; the Darne, the Madson, the Kiralyi and the Vickers Central Action. (There was then no question of even considering a cannon, although an improved Hispano was mounted in many types of the French military aircraft).

It is a reflection on our national arms policy that there was only one British gun in the contest, but in the circumstances it could not have been otherwise. The creation of a new gun costs many thousands of pounds and, without any grant from the Government, it would obviously have been unfair to have carried out months—possibly years—of research and experiment at the sole expense of shareholders.

From the start there was only one gun in it at Martlesham —the Colt. Its rate of fire was 1,200 rounds a minute, 300 more a minute than its nearest competitor. The Air Council at once plumped for it.

BROWNING GUN, .303"



Then came one of those seemingly incredible incidents that could only have happened in the World of Whitehall. B.S.A. found that it was not being invited to tender for the manufacture of the gun. Sir Geoffrey Burton, then chairman of B.S.A. Guns, Ltd., visited the Air Ministry to discover the reason. As soon as he had explained the purpose of his call, he received the astonishing reply, "You are in the cycle and motor cycle business. You are not machine gun manufacturers." Mildly Sir Geoffrey pointed out that his was the oldest armaments company in the country and that in the Great War it had manufactured every single Lewis gun used by the Navy, Army and R.A.F.

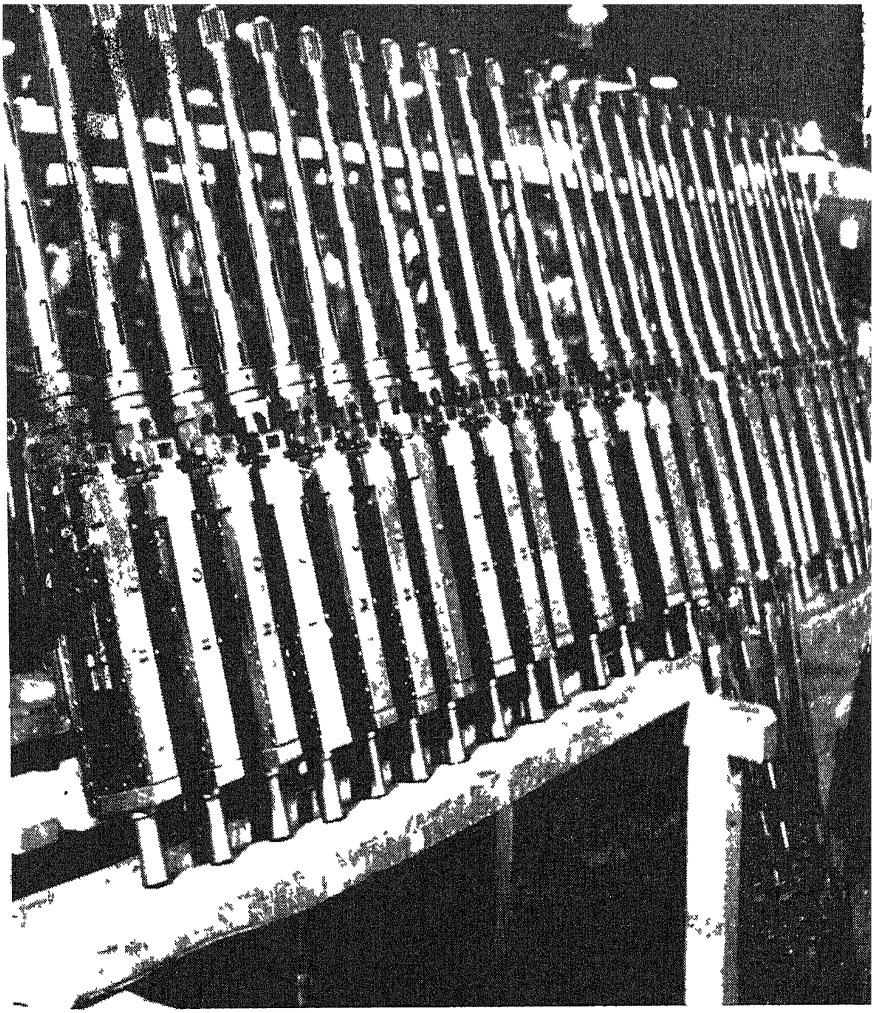
Although the interview seemingly terminated in a most unsatisfactory manner, it led the Air Ministry to reconsider the matter, for the result was that, after a set of blueprints had been received, the company was asked in June, 1935, to quote for the production of 1,050 guns at the rate of 50 a week.

B.S.A. duly submitted a tender and undertook to start deliveries 14 months from the date of the contract, which was signed on September 28, 1935. An order was also placed with another armaments firm.

A vital factor when a gun is being made by different companies is that all parts shall be completely interchangeable, and to this end (and also to further co-operation between the two firms) the Air Ministry decided to hold a round table conference with Service officials and the representatives of both companies.

To describe that meeting as having ended on a calm note would be slightly euphemistic. But it certainly led to everyone present gaining a healthy respect for B.S.A.

After the chairman had outlined the programme, Mr. Leek stated that since in his opinion a production rate of 2,000 guns a week would eventually be required, it was



◆ *READY FOR THE R A F At the peak period of production this rack of 25 303 Brownings represented only one twenty-fourth of the daily B S A output of these guns*

regrettable that output was not being planned on those lines from the start.

The statement was received with laughing incredulity "Perhaps", said the chairman, "Mr. Leek will tell us for what possible purpose 2,000 guns a week could be needed."

"From what I have just seen on the Continent of the preparations for war there (Mr Leek had just returned from Leipzig) we shall need them to defend ourselves against Germany."

Again there was laughter.

"The R.A F. will not need 2,000 guns a week for the next 20 years", was the chairman's answer. (In 1942 the Air Ministry was to demand 5,000 a week from B S.A)

But that was not the end of the meeting, for when the chairman broached the subject of close co-operation between the two companies, the chief representative of the other company concerned said, "We know we can make the gun, but we don't know whether B.S A. can". It was an unfortunate remark and was received in dead silence. Having received the chairman's permission to reply, Mr. Leek said, "I am sorry to hear you say that. We have named a delivery date two months after you, but now I will undertake to begin to deliver at the same time as you And the guns will be right. I am sorry you think so little of B.S.A. but we will prove that we can do the job."

The conference served not only to clear the position but also to bring about that co-operation which the Air Ministry wanted, for almost from that moment a spirit of mutual help was created between the two companies, a spirit which exists to the present day.

On returning to Birmingham, Mr. Leek summoned the departmental heads who would be concerned in Browning gun manufacture and told them that the delivery date had been advanced by two months to September 28, 1936, instead of November 28, 1936. And he told them the circumstances in which it had been put forward. The news spread quickly throughout Small Heath; perhaps not the full story but enough to let the staff and workers know that

their ability as gun makers had been questioned. They felt it was a challenge not only to B.S.A. but also to the Birmingham engineering industry and, most of all, to themselves, men whose forebears had always risen to an emergency when the country needed weapons quickly and in quantity. Undoubtedly it was in this challenge that there was born the spirit that made B.S.A. management, staff and workers adopt the Browning as their own gun.

In so far as the challenge from the other arms firm was concerned, the final result was that neither company was able to go into production as planned. The causes were various. First, it was discovered that there were serious discrepancies between the blueprints supplied by the American manufacturing company, the Colt's Patent Firearms Manufacturing Company, and the prototypes it had sent to the Air Ministry. Investigations showed that a number of modifications had been incorporated in the prototype guns but that no compensating alterations had been made in the original plans as supplied to B.S.A. Secondly, the Air Ministry found a serious defect in the weapon. As designed, a cartridge was left in the breech after a burst and the heat engendered by a long burst might so overheat it that it would explode some seconds afterwards. The danger was obvious and technicians from the Air Ministry and from Enfield worked side by side at Small Heath with B.S.A. gun designers for month after month to solve this and many other preliminary problems.

Despite the fact that the original order had only called for 50 guns a week (even this needed 500 machine tools, which the company, not the Air Ministry, had to buy) the directors at a meeting a few months later decided that a more realistic view must be taken of the international situation, and, on the recommendation of James Leek, planned for an output of 500 Browning guns a week. It was as well that they took

this risk, for shortly afterwards instructions were received for an output of 150 a week and this was followed in April, 1937, by an order to increase to 250 a week.

The first guns were delivered in September, 1937—17 of them—but by the following May the output was up to 685 for the month. At this stage it was decided to send representatives of the company to the United States to study American methods of production, particularly in regard to the prevention of distortion of components in heat-treatment processes. The visit proved of great benefit on both sides of the Atlantic, for while the B.S.A. technicians gathered much useful information they, in turn, were able to improve as a result of their researches at Small Heath the American technique in many important respects.

The Air Ministry soon found that even 250 guns a week was insufficient for their needs. Now that existing fighter squadrons were being brought up to full strength and new squadrons created, it was necessary to have the weapons for them. The demand for increased deliveries rose rapidly. In September, 1938, the order came for 300 guns a week, which meant operating a double shift. By the end of March, 1939, it was "600 guns a week", and in June, 1940, the order reached the figure Mr. Leek had mentioned at that fateful Air Ministry meeting less than five years before—"2,000 guns a week". B.S.A. strove to keep pace with these demands, new machines being installed by the hundred and unskilled labour trained to operate them. The 1938 output was 7,004, followed by 20,608 in 1939, while in 1940, despite the November blitz, the total reached 51,490. These figures could never have been achieved but for the constant work of the B.S.A. gun designers and planning engineers who had laboured continuously since the start of production on methods of improving output and at the same time of increasing the efficiency of the gun. Indeed the Browning

gun being produced in the early days of the war was, from the engineering viewpoint, a vastly different weapon from that which had won the Martlesham contest in 1934.

The development of the Browning gun was closely studied by the Russian military and aviation experts who recognized that in its final form, as modified by B.S.A., it was the most perfect weapon of its calibre in existence. Indeed, as soon as the Soviet Union became involved in the war, Moscow asked for blueprints and prototypes, with which request Britain at once complied. The fact that it must have been put into production at once was later revealed by an urgent request for a large number of breech blocks in order that a batch of guns might be completed. These orders were fulfilled by B.S.A. from the sub-contracting scheme's stock.

The Ministry planned that B.S.A. should reach a production of 17,300 guns in the month of August, 1941—8,500 from Small Heath and the dispersals and 8,800 from the sub-contracting scheme. This figure, which involved a daily average output of 568 guns, was not reached at the time because of the indirect effect of the Small Heath blitz. Large numbers of the machine tools originally ordered to make this expansion of output possible were, in practice, used to replace those destroyed in the raids. Nevertheless, in the following March the company came very near the mark when 16,390 guns passed through the inspection department—10,342 from Small Heath and 6,048 from the sub-contracting scheme. This figure, which represented a production rate of 543 a day, would have been exceeded but for the fact that it was at this very period that the Russian breech block request had to be met.

Such production figures might have appeared at first sight almost fantastic but they were readily understandable when translated into terms of fighters, nearly all of which carried fewer than eight guns.

This March output in fact represented the peak Browning gun output of the war since by this time the more powerful Hispano cannon, which was being manufactured by B S.A. in a shadow factory at Newcastle-under-Lyme, was coming into full production, thus enabling the R.A.F. to begin to reorganize the entire system of aircraft armament.

Perhaps the most impressive figure in the whole story of B.S.A. and the Browning Gun is the company's final production total, which, from the start of manufacture, aggregated 468,098—sufficient for nearly 60,000 eight-gun fighters And this figure does not take into account spare parts which represented just over another 100,000 guns.

◆ *Girls were continuously employed in filling belts for Browning tests—here are three girls with part of a belt of 1,200 rounds, one minute's ammunition for the Browning*

CHAPTER XII

LEE ENFIELD RIFLE MARK III AND No. 4 MARK I

DESPITE the fact that the rifle remained the chief weapon of the British infantry throughout the war, there was a steadily increasing tendency from the fall of France onwards to replace it where possible with an automatic weapon. The rifle, ideal for the static trench warfare of France and Flanders between 1914 and 1918, was not so suited to a war of movement, of Blitzkrieg, and of close-range street fighting.

The effect of the introduction of the Sten and other small automatic weapons was clearly reflected in the figures of rifle production. At the peak period of the Great War, B.S.A. output rose to 10,000 a week, but in the world war it only just attained 7,500 a week before being reduced on the order of the Ministry of Supply.

Two distinct types of rifle were manufactured by B.S.A.—the Lee Enfield Mark III, which was made at Small Heath until its production ceased in November, 1943, and the No. 4 Mark I, which was manufactured from July, 1941, onwards in a specially built factory at Shirley.

Despite the output figures of the previous war, the Mark III was not a weapon which made mass production easy. In the early thirties B.S.A. designed a new model with a view to eliminating the special tools, jigs, fixtures and gauges which complicated the manufacture of Mark IIIs, but apart from a few prototypes it remained on the drawing board until the beginning of the war.

It was in 1936 that the War Office, under the rearmament programme, gave B.S.A. an order for 10,900 Mark III Lee Enfields, the first contract for rifles from the British Government since 1919. On the actual outbreak of war the company received the instruction to which it had become accustomed after nearly 80 years of facing up to international crises—the Ministry of Supply telephoned to give instructions for the greatest possible increase in rifle production.

By the beginning of 1940 output had reached 2,000 a week and was steadily mounting when, in the August raid on Small Heath, the barrel mill was destroyed together with adjacent shops, in which a number of important operations on the rifle body and the bolt were carried out.

The following morning it appeared as if the Mark III was finished. Deep drilling and rifling machines lay among a great pile of burning wreckage; milling and profiling machines, which had crashed from upper floors, looked little better than a mass of scrap metal, and many of the jigs, tools, and gauges were irretrievably lost.

With the threat of an invasion at any moment, the country's position was desperate in regard to rifles, of which B.S.A., the only manufacturers in the country, had delivered just on 150,000 since the start of rearmament in 1936. The new Royal Ordnance Factories, erected to manufacture the No. 4 Mark I rifle, were not yet in production, while the site for the new B.S.A. "shadow" factory at Shirley, near Birmingham, where the same weapon was to be produced, had been finally selected only a few weeks before; building had not even been started. The company was certainly overhauling at the rate of 3,000 a week a batch of some 138,000 Winchester rifles, which had been stored at Woolwich since the end of the last war. Beyond these were none.

There was only one thing to do. The impossible must be accomplished. And B.S.A. proceeded to accomplish it. While repair squads worked day and night to recondition the machines, which had been dug one by one from the debris, new fixtures and gauges for the Mark III were rushed through the toolroom. In less than three months from the bombing (a period in which not a single rifle was manufactured in the country) the company was able to report to the Ministry of Supply that the Mark III rifle was again in production. But this triumph was short lived, for a few days after the recommencement the plant was again badly damaged in the November air attacks. Output started again in February, 1941, when sufficient new and second-hand machinery had been collected, but with the prospect of the No. 4 Mark I starting at Shirley it became unnecessary to extend the plant beyond a capacity of 1,250 a week, a figure reached in November, 1941.

When such a famous weapon as the Mark III with all its associations goes out of production, there is an inevitable feeling of regret. In such affection was the model held at Small Heath that after the last gun had been dispatched in December, 1943, it was decided to hold a "farewell" dinner for those members of the staff and workers who had been closely associated with its production over a number of years. Among those who attended was Mr. George Norman, a former works manager who, although 85, was retained in a consultative capacity and used to visit the works once a week. He had joined B.S.A. in 1896 and had been connected with the first Mark I Lee Enfield in 1904 as well as the Mark III in World War No. 1. During dinner he told story after story of the "good old days". And as if with the passing of the gun he had fathered so lovingly his life's work had been completed, Mr. Norman went home that night to die peacefully in his chair.

Although B.S.A. submitted a plan for the mass production of the No. 4 Mark I rifle within two months of the outbreak of war, instructions to proceed were only received on February 2, 1940. Even then there was further delay due to the difficulty of obtaining a suitable site for the new factory. At first a piece of land in Acocks Green was chosen. This was rejected a month later after a resolution had been passed at a mass meeting of local property owners, that a factory would spoil the amenities of the district. In July, 1940, a site was finally selected in Shirley and building started in the autumn, but, as could be expected, there were many stoppages because of wet weather and frost. In January, however, floor laying began, and as soon as each section was ready machines were moved in. By the time the tooling stage had been reached a new problem arose. The dispersal units had absorbed nearly all the key personnel from Small Heath and in consequence very few B.S.A.-trained men were available. In addition, the cutter requirements for Shirley were submerged in the super-priority of aircraft work at that time. The Small Heath staff, however, worked wonders. They supplied temporary cutters and fixtures and a start was made with the machine tools for the rifle body, which required 180 operations.

Working conditions were grim. At first only a very small supply of electricity through a temporary cable could be obtained. The sole source of water was a hydrant connected for the builders. For nearly a month the men worked without heating, with no roof nor walls at one end of the building, with snow sometimes a foot deep outside and, most important of all, without a canteen.

With some of the machines ready (the last of them was not delivered to Shirley until May, 1942) the next problem was to find and train sufficient workers. Gradually they were assembled—they came from every part of the British Isles and Eire—and soon settled into a team.

Shirley's task was to produce the 12 major components of the guns and assemble the guns—the small parts, most of them simple to manufacture, being supplied by sub-contractors to the Ministry of Supply.

The first 100 No. 4 rifles were produced in July, 1941, and a good start had been made with the August target of 1,000 when deliveries ceased entirely through the failure of a sub-contractor to deliver a supply of bolt head catches, a small but quite complicated component from the manufacturing viewpoint. This was bad, but worse was to come, for a warning was received from the Ministry that it would be at least two months before the firm responsible could start deliveries. Such a delay could not be brooked. The manager at Shirley set a team on making all the tools, fixtures and gauges necessary for the component, borrowed some steel from Small Heath, and within eight days turned out 300 bolt head catches.

At the peak period production at Shirley was raised to 6,000 a week and by the end of the war the total B.S.A. output of rifles including conversions reached the 1,250,000 mark.

Early in 1945 Shirley was preparing for the production of a No. 5 rifle designed by Government experts. It was in reality a modified version of the No. 4, having a shorter barrel and less woodwork in order to lighten the infantryman's load. Numbers were manufactured to enable the new weapon to be tested in service conditions, but preliminary reports indicated that further modifications might be needed before full-scale production started.

CHAPTER XIII

BESA 7 92 MM AND 15 MM MACHINE GUNS

LATE in 1936 the War Office began to seek new types of medium and heavy machine guns with which to arm our tanks and light mechanized forces. B.S.A. was aware that two such guns were being developed in Czechoslovakia, and as soon as news of Whitehall's interest reached Small Heath, executives of the company visited the Zbrojovka Works outside Brno.

There they were given a demonstration of the weapons, the Z.B. 7.92 mm. and the Z.B. 15 mm. tank machine guns. The basic principle was the same as that of the Bren gun which the British army was then in the process of adopting. The value of having a similar type of mechanism in guns filling different technical roles was obvious, the important factor being that long courses of training in the new weapons would be unnecessary for men who already knew the Bren. Both the Z.B.s were designed to give a very high performance in sustained fire without repeated changes of barrel, and so simple and robust was the design that stoppages were rare and wear negligible.

The possibilities of the weapon were enormous, and after some discussion the B.S.A. executives agreed to manufacture the smaller of the guns under licence in England, leaving the larger for later consideration. Such was the situation even then existing on the Continent that to obviate the possibility of the complete plans falling into the hands of the Germans, the B.S.A. men travelled back to England with some of the blueprints, while the rest were brought over by Czechs travelling by a different route.

The pressure on shop space at Small Heath at that time was so great—plans were already in hand for the manufacture of the Browning gun, the Boys Anti-tank rifle, and the No. 117 Fuse—that the directors decided to build a new factory at Redditch to make the Z.B.s should the War Office place an order for them. Provisional approval was quickly forthcoming and on the strength of this assurance further negotiations were completed with the Czech owners for the manufacture of the bigger weapon.

In April, 1938, 15 months after the visit to Brno, an order arrived for both types of guns and the building of a vast new factory began at once. At first B.S.A. set out to produce both guns exactly to the original designs, and in the autumn one of the company's production engineers spent nearly a month at the Zbrojovka Works, studying their methods of manufacture. By this time the international outlook was so grim—Munich had just come and gone—that the start of manufacture was accelerated, machines being moved into each section as it was completed by the builders. Within a few days of the first five key men being transferred from Small Heath early in January, 1939, production commenced and on June 27 the first 7.92 mm. gun was fired.

It was soon found, however, that drastic modifications were necessary if either gun were to be manufactured in quantity and by the time the B.S.A. experts had finished with them they were so altered that they were renamed "Besa". The result of their redesigning was soon evident, for while there had been only a trickle of deliveries of 7.92s in the first few months of production, output rose sharply to 200 in May, 1940, and steadily increased except in the blitz period until it reached the peak production figure of 2,600 in October, 1942—the time when Field Marshal Viscount (then General) Montgomery was building up the Eighth Army behind El Alamein.

The demand for the smaller Besa was greater than for the 15 mm. model and thus it was not until May, 1940, that the first batch of the larger weapon was delivered, maximum production being reached in 1942 in the summer when Rommel was sweeping forward on Egypt.

So vital was the need for Besas at that period that a convoy bound for the Middle East via the Cape—the Mediterranean was then closed to our merchant shipping—was held up for hours at Southampton while a batch of guns was rushed by road to the port so that they could be fitted to the new tanks during the voyage.

The production of the Besa in those days of peril in North Africa was increased largely through the opening of four additional factory units at Leicester.

Leicester, in fact, was the first place in Britain where barrels were manufactured without being set finally by hand. Barrel setting is an age old art in the small arms industry. The barrel is held to a north window across which is a horizontal line causing a shadow to appear on the rifling. If the shadow is uneven, the setter not only knows the exact point at which to hit the barrel but how hard to hit. He repeats the process until the shadow is symmetrical.

At Leicester, however, a new method was tried. At every stage in its manufacture the barrel was checked with gauges and finally placed in a stand at an angle of 45 degrees. A plug gauge of predetermined length and diameter was then inserted and if this slipped through, the barrel was adjudged perfectly straight. The method was widely adopted with great success at many other of the company's factories.

By the time the Besas were superseded by heavier weapons on even our lightest tanks—they remained the standard equipment on armoured cars to the end of the war—B.S.A. had manufactured 59,322 of the 7.9 mm. and 3,218 of the 15 mm., both guns which proved themselves in battle to be the superior of any similar weapon possessed by the Axis powers.

CHAPTER XIV

ARMY MOTOR-CYCLES

THE men who had made B.S.A. the greatest motor cycle manufacturers in the country were not switched to gun production on the outbreak of war; a great many were needed to produce the vast numbers of machines required by the army.

The close collaboration on design and production which had existed between the War Office and the company in the Great War had been revived in 1932 when B.S.A. was asked to evolve a special 500 cc. twin-cylinder model, a type then favoured by the military experts because of its great flexibility. So successful was the resulting machine that not only were substantial numbers supplied to the army, but a large order was also placed by the Air Ministry.

Personnel changes at the War Office in 1937 led to an alteration in policy, the new regime favouring a 500 cc. single cylinder side valve engine. Both B.S.A. and the Norton Company submitted modified versions of their standard models of this type to the Mechanization Experimental Department at Farnborough for tests, which included a 10,000 mile reliability trial in very exacting conditions.

At this period the European situation was so forbidding that army officials began to make plans to provide the thousands of motor cycles which would be needed immediately if it came to war. The hampering hand of the Treasury, even then not reconciled to spending money on rearmament, was seen in their first proposal—that B.S.A. should permanently keep in stock large numbers of machines, which the Government would buy if the necessity arose. Despite the fact that it involved locking up considerable capital in

goods which could not be sold in the civilian market, the directors took the view that, if this were the only way in which the needed reserves could be created, the company should agree to it in the national interests. But before they could give formal assent to the scheme, it was abandoned by the Government in favour of direct purchase.

Simultaneously with the putting forward of this plan, a complete list was compiled, largely through the help of B.S.A., of all stock in dealers' hands throughout the country, stock which could be impressed in emergency.

While these preliminary defence schemes were being considered, the company did not lose sight of the fact that its products must be made even more popular in the Service than they already were and teams of Army riders, mounted on B.S.A. motor cycles and coached by one of the Small Heath experts, competed in all the leading trials. Their outstanding success came in 1938 when, on 500 cc. single-cylinder overhead valve Gold Star models, they were awarded in the International Six Day Trials in Wales the trophy for the best performance by a unit of the British Army. Whether by coincidence or whether this influenced the War Office is not known, but the fact remains that a few days later a large order was received at Small Heath for the 500 cc. side-valve machines, which had been under test at Farnborough.

During the spring and summer of 1939, the company made elaborate preparations to capture some of the chief trophies at the International Six Day Trials to be held in Germany in August. On the penultimate day, however, instructions were received from the British Ambassador in Berlin for the teams to withdraw at once and return home owing to the imminence of hostilities.

In the 12 months before the war B.S.A. supplied more than 3,000 motor cycles to the army, not only the 500 cc. models

but also 250 cc. lightweights, which had first been ordered for training purposes in 1937.

On the outbreak of war the Government requisitioned every suitable motor cycle the company had in stock—690 machines—and in addition placed an immediate order for 8,000.

It was not only Britain who wanted motor cycles: South Africa, Eire, India, Sweden and Holland were also clamouring for them. The biggest overseas orders came from the Dutch Government, which had switched from German makes to B.S.A. the previous year, and in view of the fact that Holland was a potential ally the company was allowed to fulfil them despite our own shortage at the time. Altogether in the two years before the occupation of the Netherlands by the Nazis, the company supplied the Dutch Army with more than 1,750 motor cycles of the 1,000 cc. and 600 cc. types.

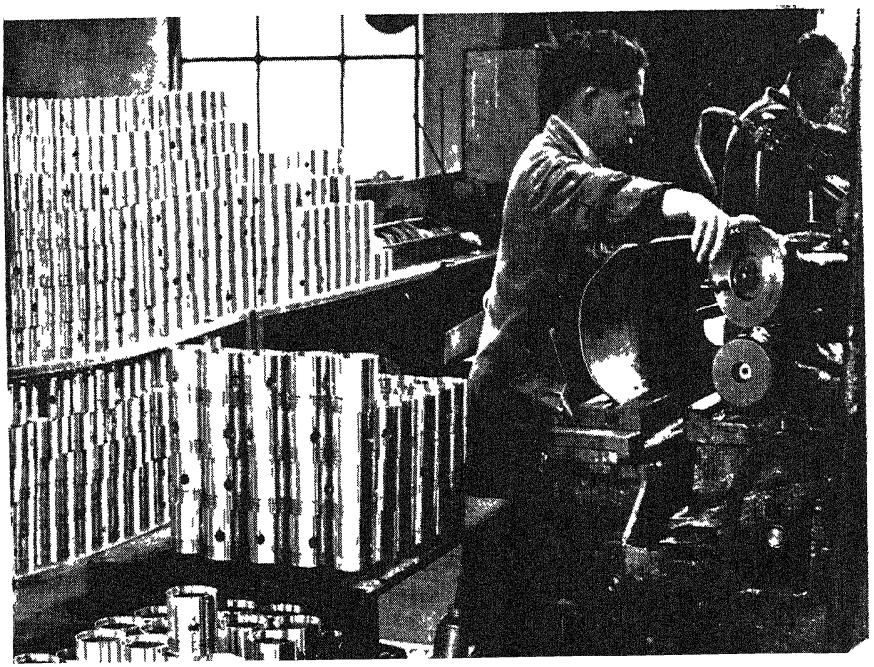
On the collapse of France, B.S.A. set out to help to make good the colossal losses of equipment, which included every motor cycle which had been taken by our expeditionary force to the Continent. The need was desperate in view of the invasion menace, and output was increased from a steady 500 a week until it attained the record figure of 1,000 a week, at which rate a finished machine was coming off the production line every 5 minutes.

During those first hectic months of the war B.S.A. delivered the prototypes of a special light 350 cc. motor cycle, which the War Office had asked the company to design for easy handling in bad road conditions. The Service experts were highly delighted with the trials and an order for 10,000 was received within a few days of their completion. It was, however, never executed. Before the necessary planning could be carried out, the order was altered to the 500 cc. models already in production. The reason for the change was

that there would be complications in spares and maintenance if the army had two main B S.A. types in service.

Not only was the company interested in supplying motor cycles to the army; it was also deeply concerned that the best service should be obtained from them. To make this possible it was suggested to the War Office that some of the company's experts should give tuition both to the men who would be riding the machines and also to those who would be responsible for their maintenance, especially in the abnormal conditions of desert warfare. The offer was immediately accepted and, in the course of the war, lectures and practical demonstrations were given to more than 250,000 officers and men in all parts of the country. Over the whole course of the war period output from the company's works totalled 126,334 of the 425,000 supplied to the War Office by British manufacturers.

◆ *Grinding pistons for B S A military motor cycles*



CHAPTER XV

PARATROOP FOLDING BICYCLES

EVERY bicycle used in action by British parachute or airborne forces during the war was manufactured by B.S.A. to the original designs of its technicians. The landings in North Africa in 1942, the D-day invasion of France, the glorious tragedy of Arnhem, the first employment of Allied paratroops beyond the Rhine when the Sixth British and 17th American airborne divisions were dropped between Xantend and Wesel in front of Montgomery's advancing forces—at all these milestones on the road to final victory these bicycles were used.

As soon as war started, B.S.A. received orders for the standard Mark V military bicycles, but they were not needed in the numbers used in the Great War. The day of the long forced march into battle had passed; the day of the mechanized infantry who followed closely behind the tanks in motor transport had come. But in the very advance of the science of warfare a new use was created for the bicycle—it would be ideal for paratroops if a suitable type could be evolved.

In 1941 the company was asked by the War Office to design a folding bicycle, which could be strapped to the back of a paratrooper. It was obvious that the B.S.A. folding bicycle of the Great War, the first of its kind to be invented, would be useless however much modified; it was altogether too heavy.

The specification called for a machine of not more than 30 pounds. Using standard parts and normal design, the company's technicians at their first attempt produced a bicycle weighing 32 pounds. This was overweight, but at

their next effort they evolved another model which only just turned the scale at 28 pounds. On submitting it to the War Office, however, they were informed that the specification had now been altered and that the machine must not weigh more than 25 pounds. Before they could even start work on this, the War Office again made a change and stipulated a machine weighing not more than 22 pounds.

This was obviously impossible to achieve with normal design; something completely unorthodox would have to be found. Before the war one of the B.S.A. cycle experts had been considering an alteration in the standard type of frame, which had remained virtually unchanged throughout the industry for 42 years. Setting to work on this new principle, a folding cycle was evolved which weighed only just on 21 pounds.

The War Office experts, while delighted with the machine, were at first doubtful as to whether it would stand up to the work for which it would be needed. It did not appear to them robust enough to be ridden over rough country. But the confidence of the B.S.A. men was justified for in its official tests it withstood infinitely harder usage than any paratroop operation could involve. So impressed, indeed, were the American and Soviet military representatives, who were present at the demonstration, that prototypes were immediately sent to the United States and to Russia.

In these trials incidentally the bicycles were not strapped to the backs of the paratroopers since it had been found that if, on landing, a man fell backwards heavily, he was liable both to injure himself and his machine. Instead the bicycles were tied to parachutes in batches of three and dropped at the same time as the men, who picked them up on landing.

Here it may be mentioned that the War Office made it clear in the beginning that the effective life of these bicycles need only be 50 miles but, in fact, they did more than 500 miles in the official tests without showing any signs of wear,

while many of them, used for ordinary purposes, exceeded 10,000 miles.

In June, 1942, the War Office placed contracts for 15,000, demanding the first deliveries within five weeks. The prototypes had been made in the toolroom and the order involved making all the necessary fixtures and jigs. Before the month was up, however, output had started and from 100 a week it rocketed until in the seventh week 1,000 were produced.

The insistence of the War Office on early deliveries could be understood in the light of later events, for this was the time when final preparations were being made for the British-American landings in North Africa.

Altogether more than 60,000 folding paratroop cycles were manufactured by the company, a figure which equalled the number of ordinary military cycles it delivered during the whole course of the war.

◆ *BLIND VIEWER* *Within a few weeks of joining the company, the blind woman (right) set up a record for the number of screw threads inspected in a day*

CHAPTER XVI

THE OERLIKON 20 MM AA GUN

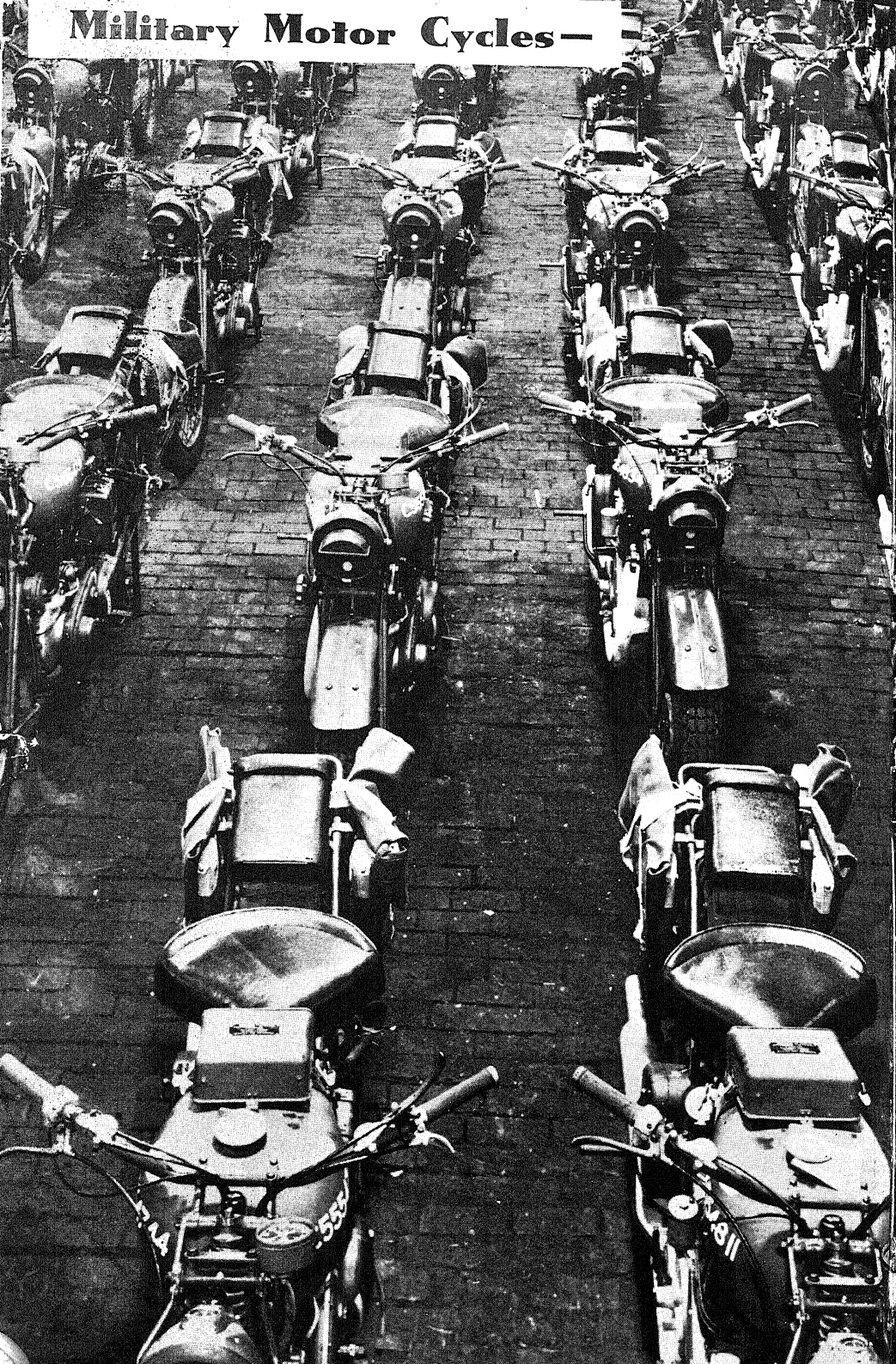
THE Oerlikon 20 millimetre anti-aircraft gun with its rate of fire 450 rounds a minute provided one of those rare examples of the same weapon being adopted by opposing nations. When it was first evolved, both the British and German Admiralties were quick to realize that the gun was ideal for use at sea and the basic soundness of their early judgment is shown by the fact that even at the end of the war it was still standard equipment in both navies. It became, in fact, more than an anti-aircraft weapon for in both our own light coastal craft and the German E-boats it was mounted as an all-purposes weapon.

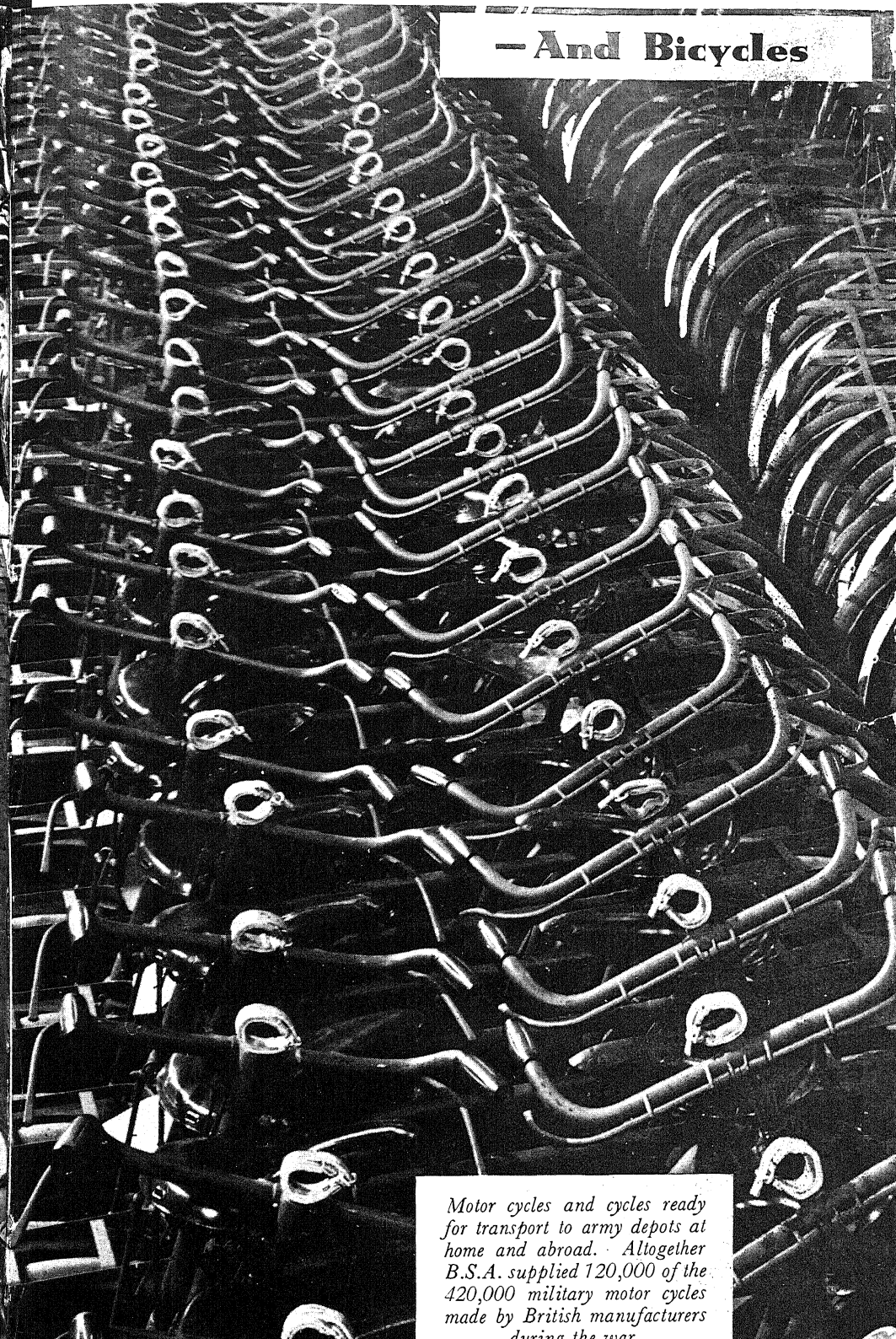
As soon as the Oerlikon was available it was mounted as an anti-aircraft gun in our merchant ships and its handiness and reliability were such that whenever a vessel had to be abandoned the crew always made every effort to take the gun with them "ready for the next time". There were many cases, in fact, where men returned to a sinking ship to remove the weapon and take it with them in their lifeboats.

The British Admiralty acquired manufacturing rights from the Swiss inventors some two years before the war but then its troubles started Search as it would it could not find an engineering company willing to produce it. No approach was made to B.S.A. (which knew of the Admiralty's plight) because of its already enormous Air Ministry and War Office commitments. In turn, six of the other leading manufacturers were asked to consider the gun but one after another declined after their experts had seen it in process of manufacture in Switzerland and had noticed the high degree of skill needed on the assembly benches. The reason was always the same: "It cannot be mass produced". Months

Military Motor Cycles—

—And Bicycles





Motor cycles and cycles ready for transport to army depots at home and abroad. Altogether B.S.A. supplied 120,000 of the 420,000 military motor cycles made by British manufacturers

One of the vast machine shops in "The Sheds", Ruislip, where Oerlikon guns were made The brick baffle walls were built to confine damage as much as possible to one section in the event of a direct hit by a bomb

"How soon do you want to go to Switzerland?" Capt. Leach.

"We will go to Switzerland after we have completed the first gun to see how much we can improve our production," was the reply.

This at once revived Capt. Leach's fears; he was still convinced that the difficulties were being underestimated, but despite this the company's scheme for the production of 150 Oerlikons a month was approved. The next problem was to find a site for a new factory for the gun since there was no possibility of squeezing the Oerlikon plant into either Small Heath or Redditch. The first location to be considered was on a farm near Brighton and an architect was actually at work on the plans when, in February, 1940, the Admiralty decided Brighton was too vulnerable to enemy air attack—a very fortunate decision in view of the later collapse of France and the German occupation of the French coast.

The next proposal was to build at Bangor, North Wales. A good site had been found in a valley, the land pegged out, a contractor's hut built, and steel ordered for the structure, when the Admiralty announced that to save time—it was now June and France had capitulated—an existing factory would be requisitioned. In the same month a meeting was held in Whitehall to decide whether to take over part of a factory at Wolverhampton or the recently-built carriage sheds of the London Passenger Transport Board at Ruislip. There is no doubt that B.S.A. would have preferred the former site; it was a Midland company and knew and was known by Midlanders, an especially important factor where labour is concerned. In addition, it was feared (a fear only too soon to be realized) that if raids started they would be chiefly directed at London. The B.S.A representative stated, however, that the company would prefer not to assume responsibility for the ultimate decision At this the Sea Lords at once plumped in favour of Ruislip So went the Oerlikon to "the Sheds", a name by which the Admiralty,

for secrecy purposes, always referred to the factory in all correspondence.

A vast amount of work had to be done before the machines could be installed. Railway lines which ran the entire length of the works had to be removed and the pits, constructed to facilitate the inspection and repair of the undercarriages of the coaches, bridged sufficiently strongly to bear the weight of heavy machinery. While this was being done an army of bricklayers, painters, carpenters and electricians began to build offices and canteens and to prepare for the installation of the plant. By this time the first raids had started and the internal reconstruction plans were amended to provide a complete system of baffle walls so that if a bomb dropped in any section of the shops the damage would not spread over the entire plant. (Despite the severity and widespread nature of the raids Ruislip escaped completely, except for trifling damage on one occasion when a land mine fell in a field three quarters of a mile away and on another when a flying bomb hit some nearby houses).

One of the chief problems at the start was the supply of power. When B.S.A. first took over there was only sufficient to run some 40 small machines and, in view of the urgency the Admiralty undertook to have a further supply brought from a sub-station three miles away by the end of September. However, it was not until December, a period of four months, that the necessary cables were finally laid. Without waiting for this supply a number of machine tools, on which the smaller components were made and for which there was just sufficient power, had been installed and started up in a part of the building previously used as a repair shop. With the arrival of bitter weather another difficulty arose. It was several weeks before proper heating could be installed and in the interval a number of charcoal braziers were kept burning. So intense was the cold at times that in this period the operators had to leave their machines every few minutes to warm their benumbed fingers.

By January, 1941, part of the main shop was ready to receive the heavy machines from America, some of which had been destined for France but which fortunately had not been delivered. Again new problems arose. In many cases the machines were not of the type specified and major adjustments, involving days of labour on each one, had to be made before they could be used.

By this time the Navy was in desperate need of the Oerlikon and the Admiralty in its anxiety asked that six prototypes should be rushed through the tool-room. Since this would have involved serious interference with the set programme—in the initial stages of a new production the tool room is the busiest shop in a plant—strong objections were offered and the request was withdrawn.

So much importance was attached to getting into production that when air raids forced the workers to go to the shelters they took with them for safety the vital sets of parts for the guns.

In April the long awaited day arrived. The Admiralty was informed that the first guns were ready. There was obvious (and very natural) anxiety on the faces of the naval officers while waiting for the firing tests. But the company officials, with their vast experience of the Besa, were confident. The guns were fired. They were perfect in every respect. B.S.A. had once again fulfilled its promise and was in production with another urgently needed weapon.

Once having started, output soared, and by November more than 1,000 guns had been dispatched. Eventually the monthly total was over the 1,000 mark, the aggregate for the whole period of the war from Ruislip being 33,000 complete guns, together with all spares.

These figures may give the impression that production was smooth. In point of fact, however, it was the very reverse in the initial stages owing to labour troubles, which were peculiar to Ruislip and which were not experienced at any other of the company's factories and dispersal units.

For some inexplicable reason the North-West area of London, in which many great aircraft factories were situated, became from the very beginning of the war the Mecca of agitators, who proved as great an embarrassment to their trade unions as to their employers. No other part of London or the country was affected to a similar degree. Slowly the various companies had weeded out the worst, who became either unemployed or went to small factories, where they had not the opportunity of influencing any large number of war workers.

This was the position when B S.A. started at the Sheds, where at the peak of production 3,000 hands were to be employed While the company at that stage of the war had not expected to get the cream of the local labour market it certainly seemed to get more than its fair share of the dregs. For the score agitators, trouble-makers and shirkers dismissed from other factories this was a golden opportunity and they were quick to seize it. There was an adequate supply of unskilled workers, but such was the urgency of getting Oerlikon into production that anyone with any pretensions to being trained was readily engaged. The first move of the agitators as they were engaged—the staff manager could not know them for what they were—was to get themselves elected shop stewards and they at once insisted on every new worker joining a union. Almost from the moment when the first machine started the troubles began. It did not take the management long to realize that the chief of the agitators was a notorious communist. From morning till night there were meetings in the shops or deputations to the offices. They seemed not in the least concerned that ships were being sunk for want of Oerlikon anti-aircraft guns; they were far more interested in the fact that the soap provided in the wash-houses was not the "right colour", that there were not enough water taps; that canteen meals were not

being served with the correct sauces. Their complaints would have been ludicrous had they not been overshadowed by the tragic loss of production time

The leaders, none of them with sufficient engineering knowledge to be in a position to appreciate B.S A. production methods, wanted to know how it was proposed to operate milling machines with unskilled workers. Experience in other factories had already proved to the management that inexperienced labour could be quickly taught to handle machinery working to fine limits of accuracy But the agitators did not understand or even desire to understand the answers.

At this time a section of the Press was giving publicity to statements by Labour Leaders that certain aircraft factory managements were inefficient and should be removed, that such statements by responsible men should be ventilated was justifiable, but unfortunately space was also devoted to interviews with disgruntled individuals, whose garbled statements presented a distorted picture of the situation Inspired by this newspaper campaign the agitators at Ruislip tried to raise the bogey of inefficient management, but although they harangued the workers continually they had no success. Next they tried to belittle the capabilities of the team of Small Heath foremen and fitters, but these seeds of discontent also fell on stony ground.

By this time at Ruislip any excuse was sufficient to stop the machines and call out the workers. Strike followed strike—all unofficial— and although for the most part they lasted only a few hours they represented in the aggregate a vast number of lost production hours. The position went from bad to worse. At last the manager asked for further skilled men from Small Heath in the hope that an additional leavening of sanity would improve the situation.

Their arrival had the reverse of the desired effect, however, for on the morning on which they started work one of the foremen (all of whom were Small Heath men trained in B.S.A. methods) came to the manager's office to warn him that one of the chief agitators was holding a meeting in the main shop and was calling on the workers to strike until all the Birmingham men had been sent home. It was a critical moment. Something had to be done. The manager acted quickly. Pushing his way through the crowd, he ordered the speaker to hold his meeting outside. For a minute it seemed as if there would be a fight, for several minor agitators gathered at the back of the speaker. But authority won and the meeting gradually dissolved.

This incident, in fact, forced the issue. At a special meeting of B.S.A. representatives and Ministry of Labour officials it was decided to dismiss the chief agitators. Immediately every worker was promptly called out on strike by the sacked ringleaders, but their authority had gone with their jobs and after two days the employees began to drift back.

The improvement in the general tone of the plant was shown at once by an increased output, and although minor agitators tried to take the place of the dismissed men they were quickly dealt with before they could cause trouble. Soon the new and untried labour force was welded into a homogeneous and happy factory unit.

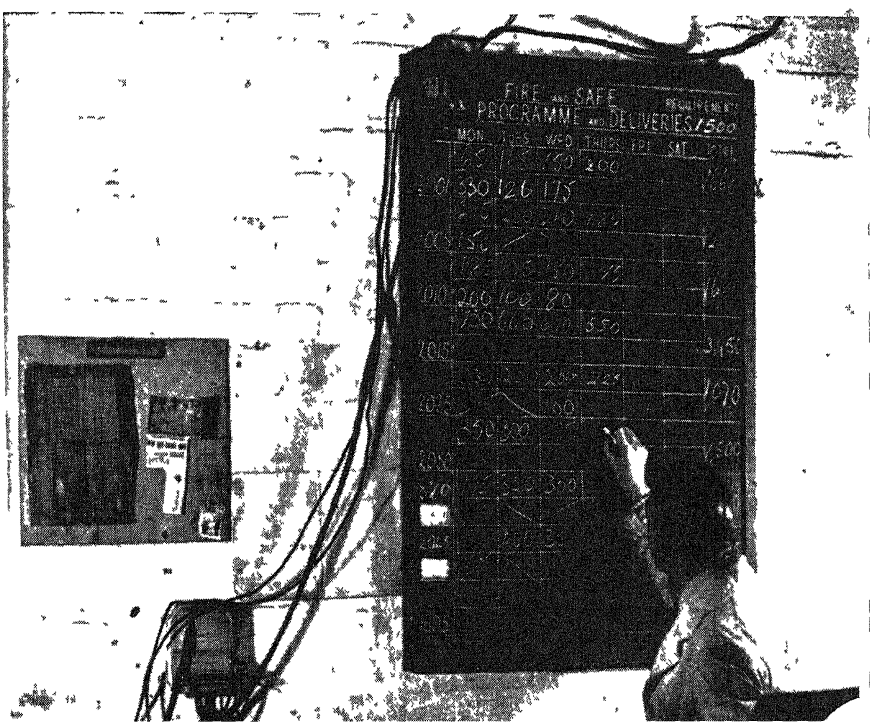
So much for the labour difficulties. The technical problems were on a different plane.

Springs play a large part in the Oerlikon—there are no fewer than 51 in each gun—and the contract called for eight duplicate sets of the principal springs with each weapon. In this connection it must be pointed out that the main spring has a firing life of 5,400 rounds, and in view of the difficulties of supply in the early stages it was felt in many quarters that the number of spares demanded was excessive.

Although from the first the Oerlikon was in almost every respect an all-Ruislip production, Small Heath undertook to supply certain components including the springs and some 15 tons of forgings a week. The springs were the chief problem and, even with the aid of three outside manufacturers, it was some considerable time before anything approaching a sufficient number of spares was available to be sent with the guns.

One of the principal causes of delay was the difficulty of obtaining sufficient quantities of the square section steel, of which the main springs were made. A large proportion of the earlier consignments had to be rejected because of their poor quality, the steel suffering from nearly every "disease" to which it is prone—cracks, seams, decarbonization up to 1/32nd of an inch deep, and variable hardness.

◆ *Every shop throughout the B.S.A. organization had a board on which was chalked the week's output target, together with each day's actual production figure.*



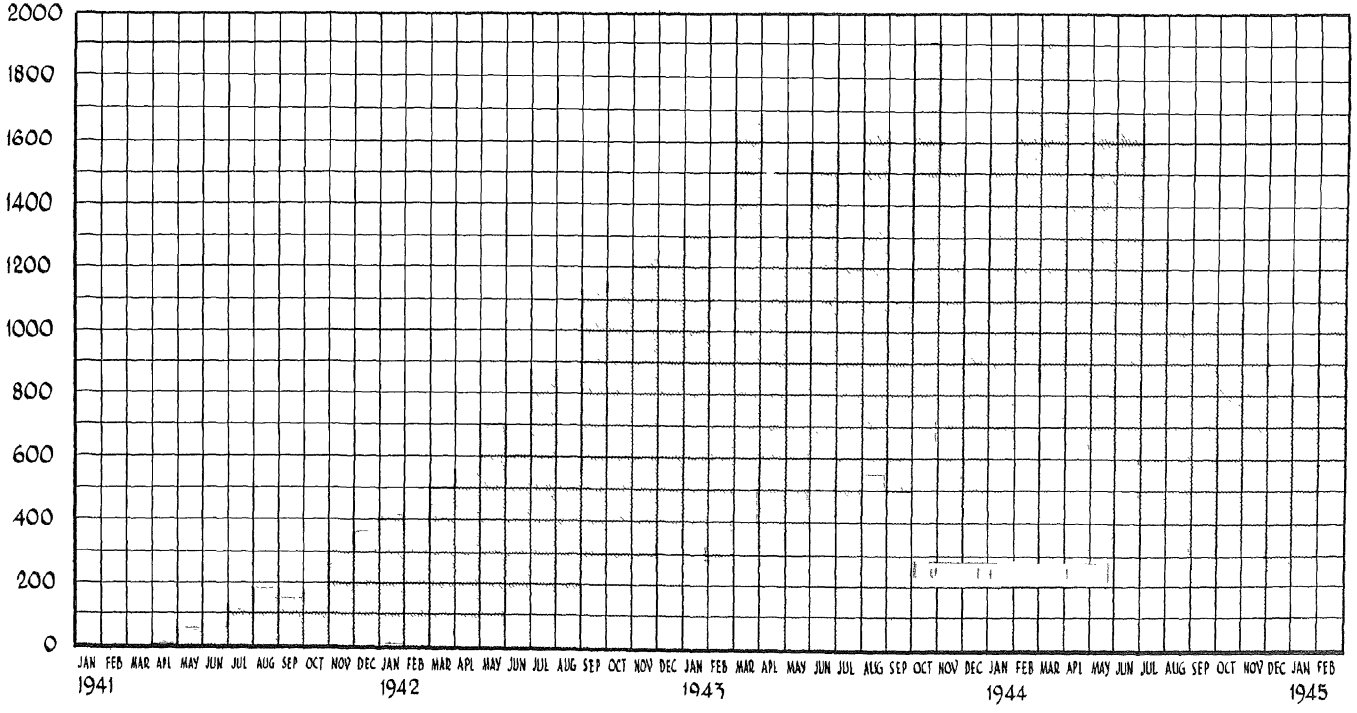
The basic cause was the raw labour which the steel makers and rod-rolling and wire-drawing manufacturers were having to employ, but after several conferences with all parties concerned, the position rapidly improved until it became a rare thing to receive a consignment which was not up to standard.

It is impossible to avoid occasional criticism and in the case of the Oerlikon a certain measure must be levelled at the Admiralty. B.S.A. realized as fully as the Admiralty the desperate need to speed up production of the guns and in the case of two of the larger springs, lack of which were holding up deliveries, it was proved after research and test in the Small Heath laboratories that they would be equally as strong and as efficient and could be made very much more quickly if round section steel were used instead of that specified.

It took a long time to convince the Naval Ordnance Department that this was so, but when eventually the point was won, and, by the acquisition of extra plant, the company was ready to double the production, the order for steel was refused on the grounds that the increase in production would "upset the Admiralty programme!" And this despite the fact that complete guns, ready to install in ships, were held up at Ruislip for lack of sufficient spare springs. That such a thing could happen at a time when for want of suitable guns merchantmen were being sunk every day by Luftwaffe sea-raiders could only indicate a temporary break-down in liaison between the various departments at the Admiralty.

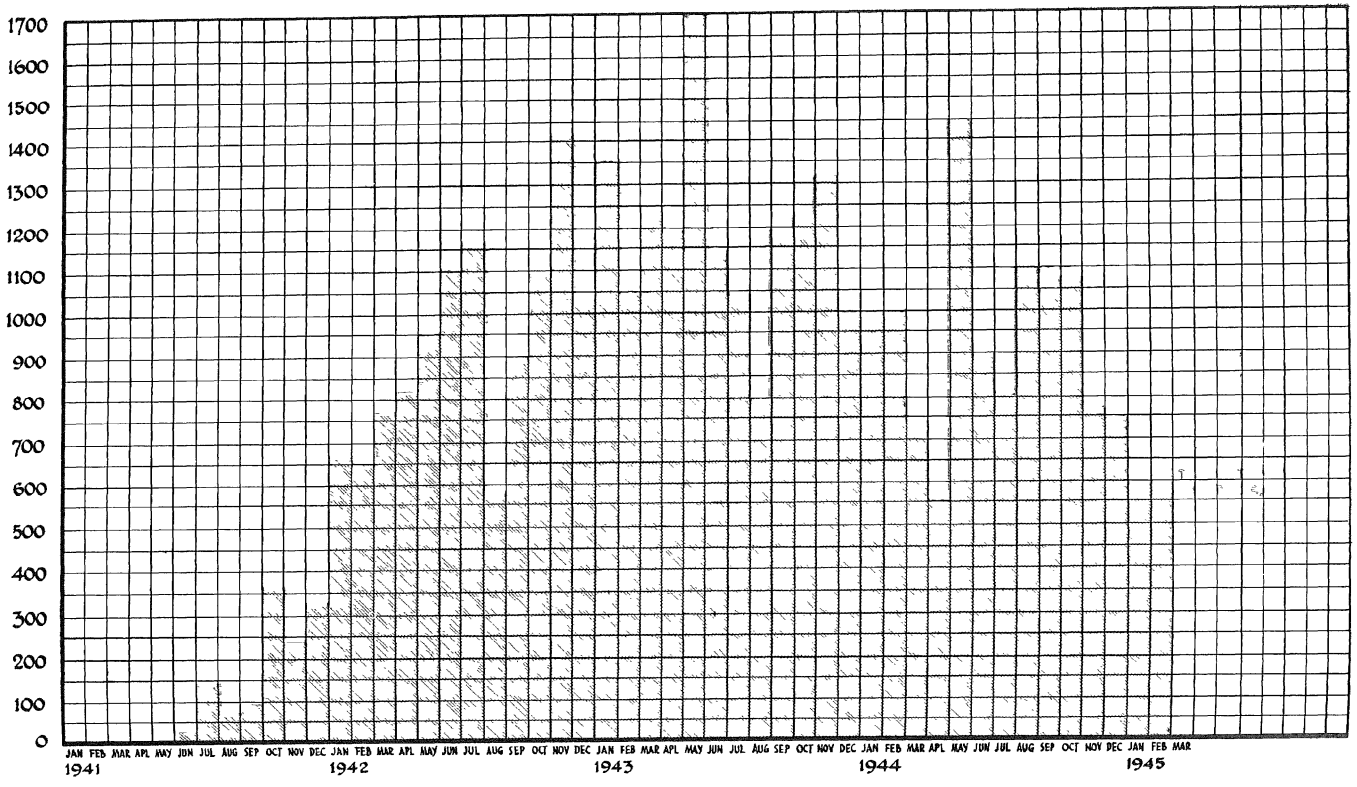
All difficulties, annoyances and delays, however, were taken in the stride of war and the arming of the Royal Navy and Merchant Navy with the Oerlikon will ever remain as a monument of B.S.A. courage and achievement.

OERLIKON 20 mm. CANNON



HISPANO SUIZA 20mm. CANNON

MONTHLY RATE



CHAPTER XVII

HISPANO SUIZA 20 MILLIMETRE CANNON

THE very excellence of the Browning gun caused at least one member of the Air Council in the years immediately preceding the outbreak of war to oppose the widest possible adoption by the R.A.F. of the more powerful 20mm. Hispano Suiza cannon with its rate of fire of 600 rounds a minute. In his opinion there could be nothing more devastating in air fighting than the concentrated fire of eight Brownings. In consequence, the manufacture of the Hispano was not pressed with the same urgency as was that of the Browning.

Although this policy was seemingly vindicated in the Battle of Britain, the Germans were quick to learn the lesson of their crushing defeat, and, even at the expense of some speed, introduced armour into their aircraft to give their pilots a measure of protection against the hail of .303 Browning gun bullets which streamed from Spitfire and Hurricane. There was a period, therefore, between the late autumn of 1940 and the general introduction of the Hispano, in which the fire power of R.A.F. fighters was not as effective against the Luftwaffe as it had been in the early days of the war.

That a cannon would be introduced into the R.A.F. sooner or later was envisaged by B.S.A. long before the war, but it was not until a few days before the declaration of war that, after months of negotiations, the Air Ministry instructed the company to proceed with arrangements to manufacture 260 Hispanos a month in a shadow factory, which had yet to be constructed.

Four sites in Lancashire and the existing British Industries Fair buildings at Castle Bromwich were considered before, early in October, a provisional decision was made to build at Newcastle-under-Lyme.

Before even the first brick of factory "81", as it was to be known, was laid in May, 1940, orders were received to plan for an output of 750 guns a month instead of the original 250. While waiting for the new works to be ready, production commenced in a very small way in March, 1940, at Radix Works, Sparkbrook, where a few machines, some old, some new, were installed to manufacture the Hispano mountings which had to be fitted into the wings of the aircraft.

A start was also made on recruiting labour in the area of the new factory and some 40 men and women were drafted from there to Sparkbrook, and for a few weeks instruction in operating machines proceeded hand in hand with the production of a limited number of the gun's 200 components. Then came the Small Heath raid of August 26, and although the damage was trifling it was decided that the plant installed at the Radix works should be transferred immediately to dispersal units in the Newcastle area.

Stoke, being near the new factory, was a most suitable centre, and within a week three small premises, two pottery works and a garage with an aggregate area of no more than 14,000 square feet, were found. As offices the manager used a small requisitioned house, the kitchen of which was converted into a laboratory where the metallurgist carried out hundreds of analyses of raw material.

Although few of the new employees had any experience of high precision work—most of them had never seen a machine tool—they learned with astonishing speed; in fact after only three days' tuition one girl was operating five milling machines as capably as though she had been accustomed to the work for years.

Meanwhile there were serious delays in the erection of the new factory. Wet weather, non-delivery of materials, frost, more wet weather—all prevented the contractors from being able to fulfil their promises, but eventually on February 13 it was possible to occupy a corner of one shop. At first it was difficult to secure an adequate supply of labour. Two new armament factories, completed in 1938, had absorbed virtually all the available labour, skilled and unskilled, in the district. Little help was forthcoming naturally from some of the local pottery owners, who feared their works would be denuded of labour; it was a case of personal against national interest, but eventually they accepted the inevitable and the Hispano works became fully staffed with 2,200 hands. Of the 100 men in the tool room, four only had previous experience of high precision work; the rest, recruited from garages and local engineering shops, were accustomed to rule-and-caliper methods; many of them had never previously used a micrometer; few of them had ever seen a grinding machine or, for that matter, any other precision tool room equipment. In spite of this, however, the foremen worked wonders with the motley team, which soon became highly proficient.

Before even a single component had been made at "81" the Ministry decided it would need the Hispano in still greater quantities than the already amended figure of 750 a month, and to make this possible a further large number of machine tools, mostly from the orders originally placed in the United States by the French Purchasing Commission, were allocated to Newcastle.

By the time the first machines started at the factory the R.A.F. was pressing for deliveries. It did not have long to wait, for on April 12 the first gun was completed and by August, when the building was finished, deliveries had reached the 200 mark; by the end of 1941 they had more

than doubled and were on their way to the 1,300 a month achieved in the December. The peak month came in October, 1942, when no fewer than 1,650 were delivered. By the end of the war B.S.A. had delivered 42,532 complete guns to the Royal Air Force.

In the early stages one of the limiting factors in production was the supply of the six-foot long barrels, each of which took 6 hours 45 minutes to drill.

B.S.A. technicians set to work to improve this figure. As with most research work, at first there were many failures. New cutting tools—D-bits—were designed and made, only to need replacement after they had drilled two or three barrels (the American D-bits then being employed were drilling as many as 150 barrels). But the research went on. Various tool steels were tried. New designs were introduced. At last one was devised which bettered the performance of

◆ *On a special watch tower at the Newcastle-under-Lyme factory a B S A Home Guard unit mounted an Hispano cannon as an anti-aircraft weapon*

the American tool. With it the drilling machines could be run at 500 revolutions a minute compared with 350 revolutions, thus reducing the time taken to drill a barrel to 4 hours 40 minutes. Still the B S.A. men were not content and within a year they evolved a D-bit which would drill a barrel in 1 hour 16 minutes with the machine running at 1,250 revolutions a minute. In fact, the drilling time was no longer limited by the bit but by the machines, which were not capable of running at higher speeds And up to 200 barrels were being drilled by each bit.

In addition to the actual guns, B.S.A. also manufactured vast quantities of Hispano spares and accessories, including the continuous feed mechanism and magazines. At first pilots reported frequent choking of the magazines, which were made to the specification of the Ministry of Aircraft Production, but although exhaustive tests were carried out on the company's ranges on no occasion was there any stoppage. The complaints, however, continued and it was decided to send engineers from Small Heath to make a first-hand investigation. On visiting various aerodromes from which Hispano-equipped aircraft were operating the reason was quickly found. It was the old story of the difference between results obtained in laboratory and testing ground and those obtained in actual operation. The B.S.A. men discovered that the cause was the centrifugal force set up in the shells by the higher turning speeds of the new planes and that the trouble could be rectified by introducing a positive feed into the mechanism. After continuous experiment and test over a period of weeks, they were able to present the R.A.F. with the feed mechanism so modified as to make it 100 per cent efficient in service conditions.

Towards the end of 1943 the Ministry of Aircraft Production began to search for a factory equipped with suitable machinery and a staff of workers already trained in high precision work; it was required for the Rolls Royce jet

engine which was ready for mass production. The Hispano plant was ideal for the purpose and B.S.A. was asked to consider the question of moving to an alternative factory in Newcastle-on-Tyne and at the same time to indicate what the move would cost in temporary loss of gun output.

Realizing the paramount importance of the R.A.F. possessing jet aircraft at the earliest possible moment, James Leek signified his willingness to move the Hispano as soon as Rolls Royce required the factory, but he made it clear that he had the strongest possible objections to Newcastle-on-Tyne works, which he had visited. Not only was the type of labour available unsuitable but the north-east coast was so far away that a B.S.A. factory there would be deprived of the practical co-operation which linked all the company's works in the Midlands. In addition to increased transport difficulties there was also the very important point of close supervision of production. To visit Newcastle-on-Tyne would involve a whole day of travel—and there were some 40 other factories and dispersals to supervise.

When, despite these objections, the company was informed that the decision that the Hispano should go to the Tyne had been made and could not at that stage be altered, James Leek decided to present his case personally to Sir Stafford Cripps, Minister of Aircraft Production. He placed before the Minister a file containing two schemes, one dealing with the move to the north-east coast and the other with a move to the B.S.A. factory at Redditch, where the manufacture of Besa, owing to the introduction of more powerful tank weapons, was being steadily reduced and where in consequence there was becoming available an increasingly large number of trained workers. Within three minutes of Sir Stafford examining the two schemes James Leek had won his case. The earlier decision was reversed and instructions given for the Hispano to go to Redditch.

The transfer, which was completed by the end of April, 1944, was so organized that there was but a trifling drop in output, which continued at 1,000 a month, a remarkable tribute to the men who arranged it.

The handing over of Factory "81" was not the only contribution made by the B.S.A organization to the development and production of jet engines. One of the companies in the group, Jessop & Sons, of Sheffield, evolved a special chromium-nickel steel required for the jet engine blades, which were subsequently manufactured in B.S.A. factories for both de Havilland and Rolls-Royce.

In the autumn of 1943 the company was asked, as a matter of extreme urgency, to make both the nozzle and rotor blades for the de Havilland engine. The drawings were accompanied by prototype blades but the latter were tool room made; the problem was to evolve a mass production scheme in which semi-skilled labour could be employed.

The work was entrusted to the superintendent of a shop, who in a few days hit on a plan by which the nozzle blades could be made. By an elaboration of the technique used to manufacture petrol engine cams, he adapted machinery to produce the blades, three at a time, on grinding machines (they could not be turned, a simpler process, owing to the toughness of the material and the superfine finish required).

The rotor blade, however, was an entirely different proposition. Due to its concave and convex surfaces of differing radii and to the fact that the thickness of the blade varied throughout its length and breadth, it represented the most difficult single component made by B.S.A. during the war.

The superintendent set to work and for weeks his tool room men were making fixtures and gauges to his dimensioned sketches. He would explain these sketches in detail until he was certain that his requirements were completely understood, a necessary step in view of the fact that most of the

sketches were drawn in the palm of his hand! Eventually the first machines, each a maze of reciprocating and oscillating fixtures working from master cams, were ready and were soon being operated by girls.

Prototype engines and drawings, together with all production schemes, were flown to America where the manufacture of the blades was entrusted to a number of American turbine companies. The latter were soon in difficulties, however, and a party of their technicians came to Small Heath to study B.S.A. methods. Just before they left, after a week's stay, they paid a final visit to the rotor blade machine line. As they stood watching they were asked whether they had everything they wanted.

"There's only one thing more we'd like to take back with us," said the leader of the party.

"What's that?" was the query.

"Him," said the American, nodding towards the superintendent.

◆ *So great was the intake of women labour into war factories that whole sections—such as this filing section below—were staffed only by girls.*

CHAPTER XVIII

FACTORY IN THE CAVES

THE strangest factory ever operated by B.S.A. during the war was 100 feet below the ground in the centuries-old galleries of the Bath Stone quarries at Corsham. Here in a maze of passages and side-workings, safe from air attack, was set up a new Hispano barrel mill. The work of converting the caves for military purposes began some two years before the war but it was not until towards the end of 1941 that the company was informed that it would shortly be allocated a part of the caves (the other portion was used by the Bristol Aeroplane Company for the manufacture of aircraft engines).

If ever there was a nightmare job from the planning engineer's point of view it was at Corsham. There was never any question of a production line in its ordinary meaning. Instead it was a question of placing two or three machines in one alcove and another batch, perhaps four or five, in the next recess. Sometimes, in the case of the biggest machines, some of them 33 feet long and weighing nearly seven tons, it was a matter of finding a place into which they would fit! And this cubist jig-saw work was not rendered any easier by the Ministry of Aircraft Production. On several occasions the company's engineers had finished planning a particular area only to be informed that B.S.A. could not have that particular space but would be allocated another in due course. This new space was always of a different shape. And shapes were everything at Corsham.

The first B.S.A. engineer sent to explore the site had many adventures. After a 90-mile road journey he came to a part of the countryside dotted here and there with building

contractors' huts. On roads, newly cut through fields, were dozens of motor trucks filled with rock and rubble which they were carrying away from a long low building. In this building was the end of a conveyor belt bringing the material from the caves below.

At that time there were neither moving stairway nor lifts, these were to be installed later. The only means of access to the caves was to walk (or slide) down a "slope shaft" in the centre of which ran the conveyor belt. The mud on both the "up" and "down" gangways was kept liquid by the water dripping in a constant stream from the roof, and to prevent workmen from precipitating themselves down the shaft, rope hand rails were attached to the wall on each side.

Below there was a scene of intense activity. Every minute there arrived from various parts of the workings small diesel-engined trains with stone-filled trucks, the contents of which were loaded on the belt.

◆ *Queen Mary with a worker during a wartime tour of the underground factory at Corsham*

Armed with a master plan, on which every pillar was numbered, the B.S.A. man moved off to find the company's site. The lighting was very poor, there being at this time only one low-powered bulb every 20 yards or so. And this scanty illumination was confined to the "main road", along which also ran the tracks of the light railway. Every few minutes there would come a piercing whistle and a train would come tearing out of the gloom. All he could do on these occasions was to flatten himself against the wall and hope for the best.

At last he saw what seemed a familiar looking number on one of the pillars. A glance at the plan confirmed his worst fears. He had reached the B.S.A area. And what an area! It seemed impossible that order could ever be brought out of such chaos. In places the ooze was nearly a foot deep Everywhere was the drip of water, the sound echoing weirdly in the semi-darkness Depressed at the immense amount of work still to be done, he wandered off into one of the unlighted side roads, using his torch to find his way. Here it was even worse. Soon he was lost. An avenue which, he reasoned, should have brought him back to the main road merely curved away downwards. For half an hour he wandered about until eventually he came across a labourer who guided him back to the slope.

In a few months, however, the scene had altered out of all recognition. In place of the slope, entry to the B.S.A. section was gained by a large lift which could take down 40 people at a time (in the very much larger area occupied by the Bristol Aeroplane Company, which employed 2,000 hands against the B.S.A.'s 300, a moving stairway was built). Electric lighting had been installed throughout The floors had been concreted, the walls sprayed with cream paint, and, where necessary, metal sheeting fixed to the roof at an angle to lead the dripping water to pipes in the wall A vast pumping system kept the workings dry, while a wind tunnel had been constructed to circulate fresh air throughout the plant. The main tunnel, which ran southwards for miles as the result of centuries of stone working, had been sealed. In addition to machine shops, store rooms, and a laboratory there had been built canteens, a surgery and a complete set of offices.

When it came to moving in the machines, it was not just a question of lowering them down a shaft but, in the case of

the larger ones, of planning the underground route by which they would travel to their appointed places. Some of the tunnels were too narrow and a roundabout way had often to be taken before they could be installed. The B.S.A. shaft was too narrow for the largest machines, which had to be lowered down a bigger one constructed for the Bristol Aeroplane Company.

It was down this shaft one day that a 33-foot rifling machine slipped from the tackle and broke into three pieces as it hit the rock floor at the bottom. One piece 12-foot long and weighing at least 3 tons crashed through the roof of a shed let into the wall at the base of the shaft. Two men were sitting, one on either side of a table, checking the numbers of the machines as they arrived. The broken part of the machine hit the table and smashed it to matchwood, but by a miracle neither man was even scratched.

To ensure continuity of production, a nucleus of trained operators was brought from Newcastle, and as each machine was installed so it was started. For these workers hostels were built above the quarry near a recreation centre in which was housed a cinema, a dance hall, and a library.

Every day there was a thorough examination of the workings by special inspectors who, by tapping roof and walls, were able to detect immediately any fault in the rock. Throughout the whole period of the use of the caves for war production, however, there was not a single major fall of stone. In fact, the only untoward incident of any consequence, in so far as B.S.A. was concerned, was the flooding of the pits dug for the heat-treatment furnaces. One morning, some days after a heavy fall of snow had melted, the pits and furnaces were found two-thirds full of water, which had seeped through the lower strata of rock beneath the level of the floor. Large quantities of liquid cement were pumped round the pits to seal the strata and similar trouble was never again experienced.

Production began in August, 1942, and soon output reached a peak of 1,500 Hispano and 500 Polston barrels in one month (the Polston, also a 20 mm. barrel, was being manufactured to Ministry of Supply order.)

From its inception it was impossible for any unauthorized person to gain admittance to the underground works for there were no fewer than four police controls, at each end of which every worker's pass was scrutinized and checked. It must certainly have been easier to escape from a German concentration camp than to enter the Corsham plant.

Although the whereabouts of Britain's underground war factories was kept secret, it is doubtful whether the Germans did not know about Corsham, for their Intelligence Service in this country in the late '30s was remarkably efficient and it is scarcely likely that even the preliminary work would have escaped the attention of their agents. Indeed, there is the story of a high official of the German Embassy in London who was invited to a social function at Bath just before the war. "Bath? Bath?" he queried—"Oh, I remember. It's that town near Corsham."

As it turned out Corsham was the only underground factory operated by B.S.A. during the war although in the dispersal of the Browning gun after the November blitz there had been a suggestion that plant should be installed in the caves under Dudley Zoo. A considerable amount of work was carried out by the Ministry of Aircraft Production before it became apparent that, in the event of a bomb falling on the ground overhead, there would be a considerable risk of the roof collapsing. The project was accordingly abandoned.

CHAPTER XIX

ANTI-TANK GUNS AND PROJECTILES

WITH the knowledge that tanks would feature largely in any future war (although no one realized what a supreme part they would play) the War Office began to consider in the early '30s the possibility of designing an anti-tank rifle which could be operated easily by one man. Eventually such a weapon was evolved by Capt. Boys, then Assistant Superintendent of Design at Enfield, but it was by merest chance that B.S.A. came to manufacture it. James Leek happened to call at Enfield just as the question of its probable cost was being discussed. As a matter of passing interest he was asked to give his estimate. After a 10-minute examination he named a figure at which he would be prepared to make 2,000. The price was so low—nearly 50 per cent below that suggested by another big engineering company—that within a few days of his visit instructions reached Small Heath to proceed with the manufacture of eight sample guns, the first of which was delivered in January, 1936. Two months later there came an order for 695, followed in the December by an order for 5,338. From that moment there was continuous rising production until the bombing of the barrel mill in August, 1940. This brought output down from nearly 1,800 a month to 800 for September—and even this involved the use of nearly all spare barrels. By November, due to this shortage of barrels, deliveries dropped to fewer than 300, while the November blitz stopped production altogether. Deliveries were not resumed until the following April after the plant had been dispersed to six factories in the Mansfield area. In 12 months, however, output was exceeding the previous record figure, reaching and maintaining a total of more than 2,000 a month.

After the fall of France, in which the Boys rifle had proved itself a satisfactory weapon, the Germans at once began to increase the strength of the armour-plating on their tanks. The arrival of the Afrika Korps in Libya showed that, except against mechanized transport and the lighter Italian tanks, the Boys was not as effective as it had been and that a new weapon was required. However, manufacture continued on a steadily decreasing scale until August, 1943, by which time nearly 69,000 had been made and delivered by B.S.A.

Of the Boys Anti-Tank rifle can be told one of the best stories of the war. It concerns a senior Government official who, when faced with a request for steel, inquired with great indignation why, when the country was needing every available weapon, the company still appeared to be making great numbers of rifles for boys!

Another anti-tank weapon with which B.S.A. was intimately connected was the two-pounder quick-firing gun. Until shortly before the war all carriages for these guns were made at Woolwich but some months before Munich the War Office decided that production would have to be greatly increased. In consequence B.S.A. was given a contract to manufacture 300 undercarriages and sets of sighting gear and to assemble the complete carriage, the other parts being made elsewhere and delivered as "free issues".

The first of the gun carriages was ready in March, 1939; by the August, 30 had been delivered and output was steadily rising.

Early in 1940 expansion of the Browning gun plant at Small Heath forced the management to remove production to a neighbouring factory at Sparkbrook where it remained until the works were burned out in the November blitz. A few completed gun carriages were saved—they were wheeled into the street and parked in the yards of neigh-

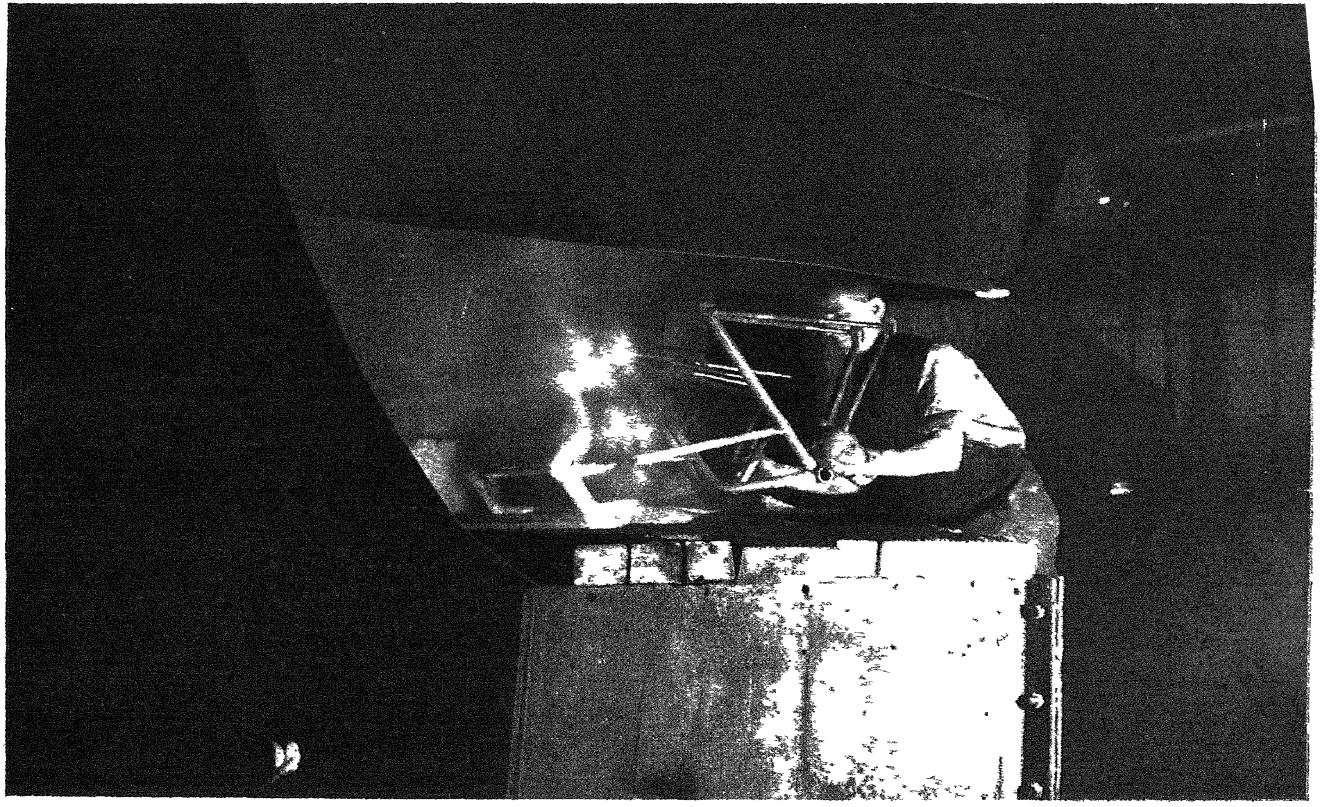
bouring houses—but practically everything else was destroyed or badly damaged, including a hugh stock of new tyres.

Two months later a new home was found for the gun carriages in an old paper mill at Tamworth. Almost before the Ministry of Supply had been able formally to requisition the buildings, B.S.A. had arranged with the local authorities to lay on gas, water and electricity. At the same time machines and components salvaged from Sparkbrook were transported to Tamworth; the men, who had been engaged on assembly, turned themselves into labourers and helped the wheelwrights to load and unload the lorries in order that output might be resumed with the minimum delay.

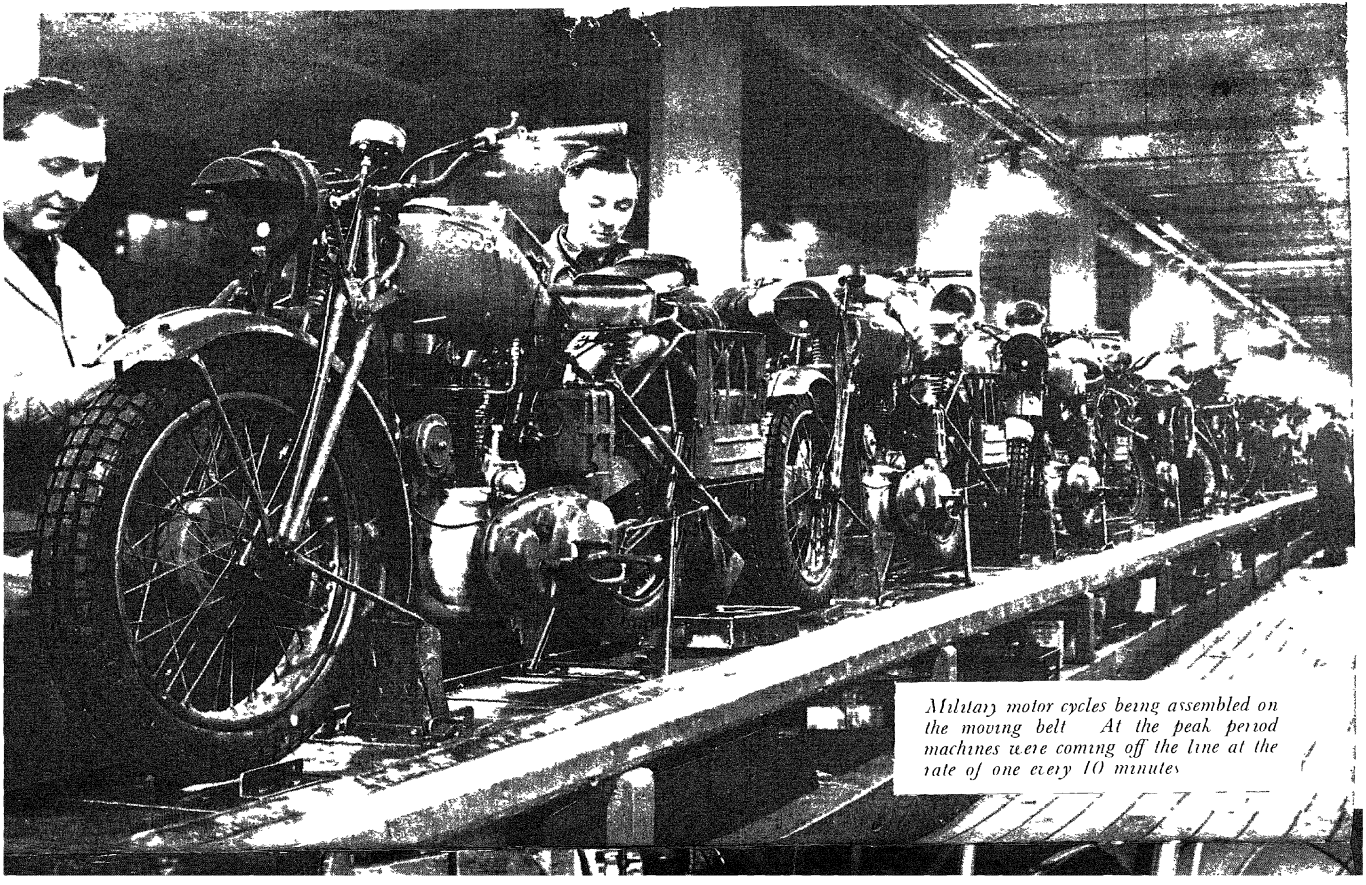
Although the mill was not taken over until January, 1941, the first Tamworth-made carriage was completed by the middle of the next month, and by June 230 had been delivered, bringing B.S.A.'s output since the beginning of the order to 1,000. By the time the contract ended in September, 1943, a total of 4,150 carriages had been supplied, together with large quantities of spares. As soon as the last batch had been completed, work began on new orders—ammunition hoppers and the rear lifting gear of the new six-pounder twin anti-aircraft gun.

Routine work at Tamworth was frequently interrupted by special contracts. On one occasion the workers were asked to rush two experimental crates, by which two-pounder guns could be slung in the bomb rack of a Halifax and dropped to Resistance Forces in occupied territory; on another—an urgent call came for 100 special model two-pounders for the use of paratroops. The last of these were delivered only a few days before the first landings in North Africa.

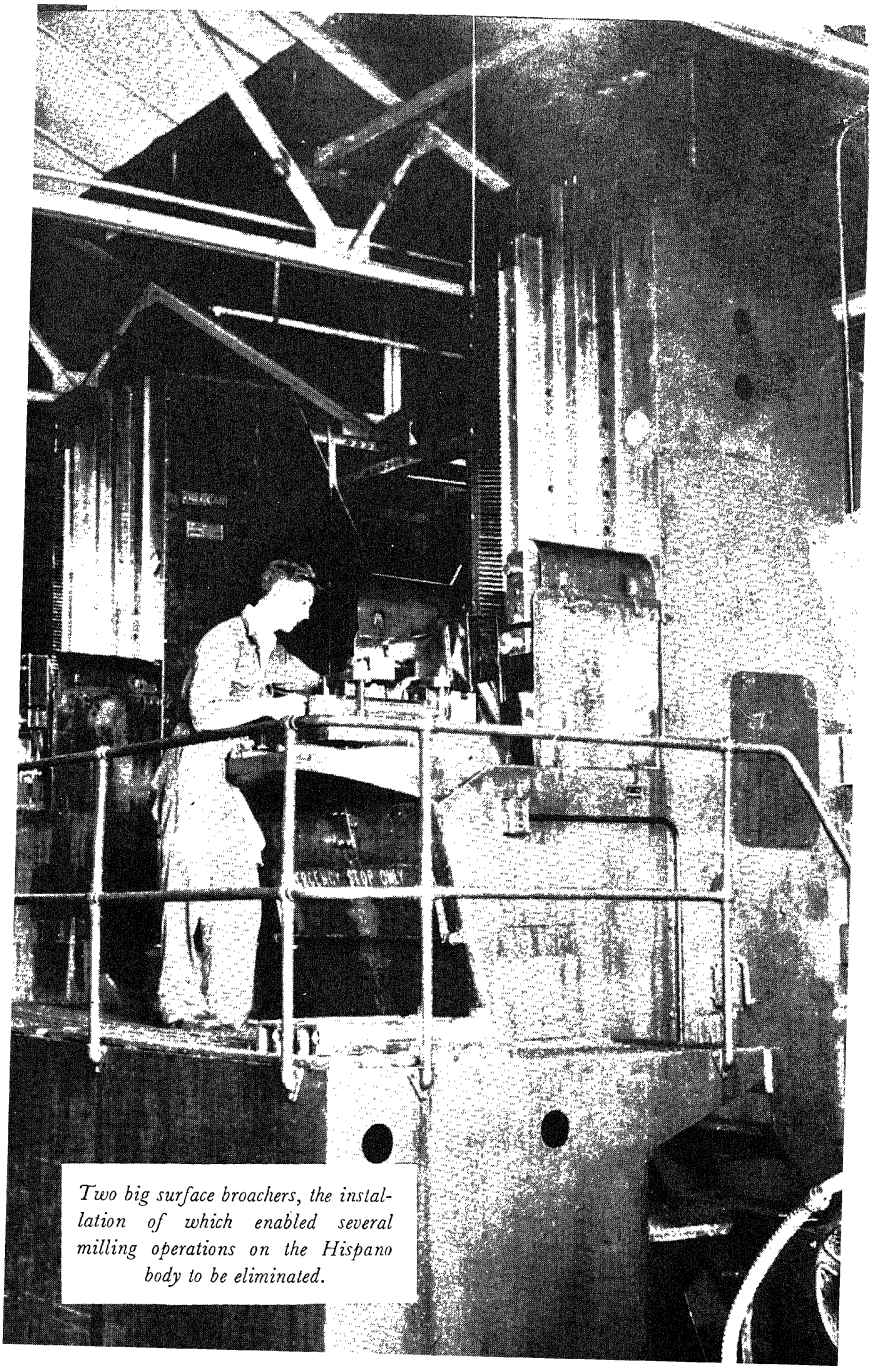
To synchronize production where a great number of different contractors and sub-contractors are involved is always a matter of considerable difficulty and the two-



◆ *Dip-brazing a cycle frame.*

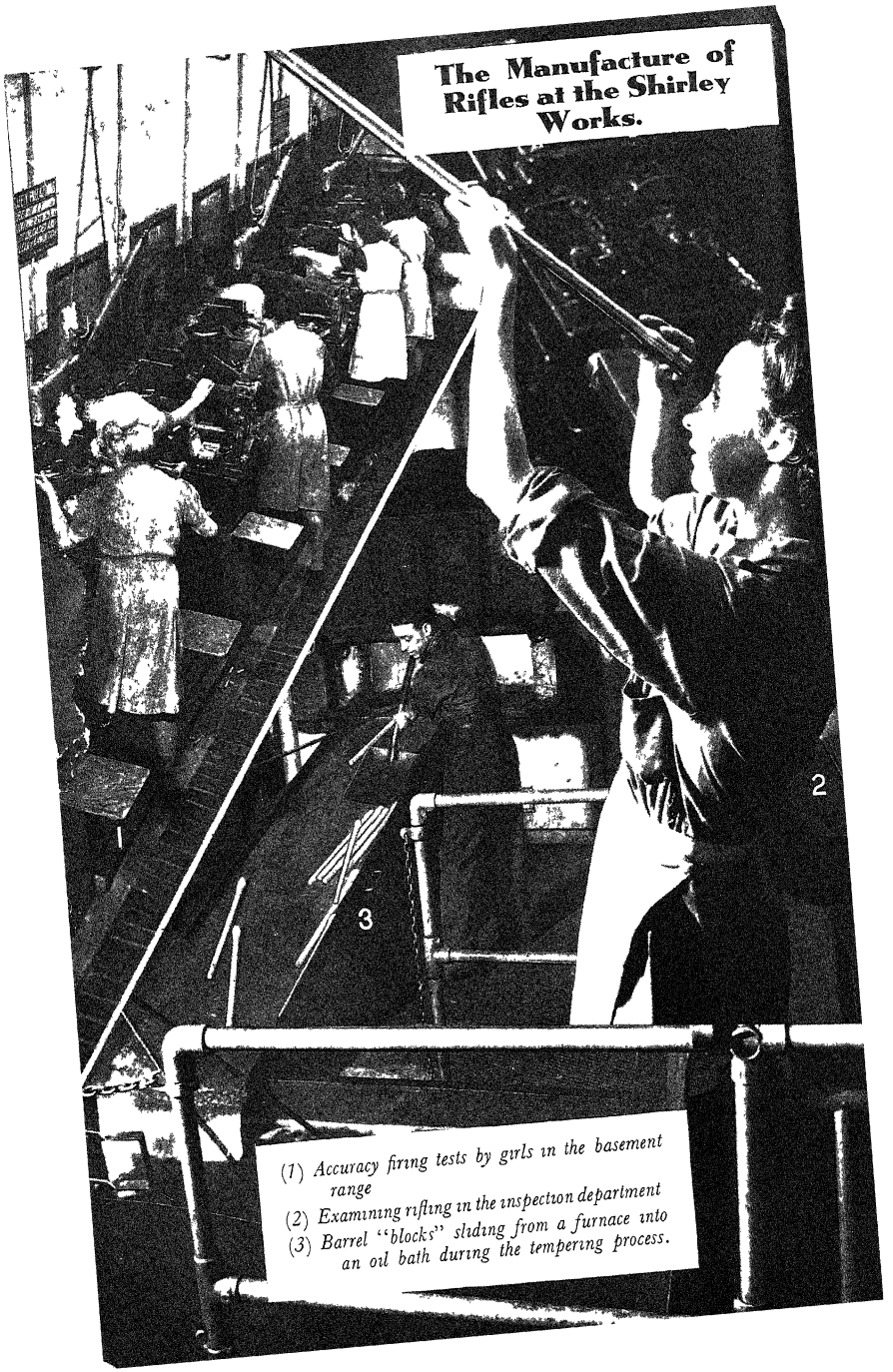


Military motor cycles being assembled on the moving belt. At the peak period machines were coming off the line at the rate of one every 10 minutes



Two big surface broachers, the installation of which enabled several milling operations on the Hispano body to be eliminated.

The Manufacture of Rifles at the Shirley Works.



(1) *Accuracy firing tests by girls in the basement range*

(2) *Examining rifling in the inspection department*

(3) *Barrel "blocks" sliding from a furnace into an oil bath during the tempering process.*

pounder gun carriage, in the manufacture of which more than 50 firms were concerned, was no exception. So great was the need to increase output in the early years of the war that the Ministry of Supply formed a co-ordinating committee under the chairmanship of Mr James Dickinson, Works Manager at Small Heath. It was in no small measure due to the work of this committee that the flow of the carriages to the Middle East was increased at a time when the Eighth Army most needed them.

It was late in 1940 when the War Office decided that, although the Boys Anti-Tank gun had done and was doing yeoman service, a new type of shell or projectile must be found which would prove effective against the heavier armour of the latest German tanks.

Work on just such a projectile had been in progress at Small Heath since 1938. In December of that year, ten days after Mr. Chamberlain's return from Munich, there arrived at the company's offices Frantisek Janecek, son of Dr. F. Janecek, a Czechoslovakian arms manufacturer. He quickly explained the reason of his visit. Neither he nor his father believed that it would be "peace in our time" despite the British Prime Minister's apparent faith in his own words. They were convinced that in a few months Germany would seize the whole of their country. He and his father had been working on a new type of ammunition and gun for the Czech army, but they also wished their potential Allies, Britain and France, to have it. Prototypes of the new weapon were, in fact, already in course of construction at their factory but (said Janecek) he wanted to continue his research work free from all possible German interference. Even to the firm's technicians, accustomed to and appreciative of novelty as they were, Janecek's design appeared most original; they were convinced that it was worth full investigation and accordingly he began to work at Small Heath.

An Englishman is the hero of the next incident in the story of this weapon.

In March, 1939—four months after research had commenced at Small Heath—the Germans marched into Czechoslovakia and within a few hours Nazi military experts were at the Janecek factory. Through their intelligence agents they knew that a new secret weapon was being evolved there but when they arrived, the prototypes had vanished.

The previous evening the Englishman, who was employed at the factory, heard from a secret source that the Germans were planning to march in at dawn the next day. He promptly packed the prototypes into cases, put them into his car and deposited them just after midnight at the British Legation to be forwarded to London.

The subsequent adventures of those cases is still a Foreign Office secret. That the Germans did not get them was soon obvious, for a little later they combed the baggage of British officials for them in defiance of the fact that, by accepted international practice, members of the Diplomatic Corps are immune from search. Three months later notification was received that the cases containing the prototypes were awaiting collection at the War Office.

That was not the last adventure that this Englishman had in connection with the weapons. Shortly before the outbreak of war he decided to return to England, and in the car in which he and his family were travelling to Paris he hid some of the latest blueprints of the projectile hoping that somehow he would get them over the frontier. Luck was with him. As he arrived at the frontier post at which Gestapo men were on duty, Hitler was broadcasting. The guard was drawn up as if on parade and was too busy "Heil Hitlering" to pay more than perfunctory attention

to any traveller at such a moment. Thus the drawings reached England.

Soon after the arrival of the prototypes Mr. Janecek left Small Heath to work elsewhere. In due course a number of experimental projectiles was completed, but after a demonstration the War Office decided not to adopt the new weapon. B.S.A. faith in the Janecek principle was not destroyed by this rejection, however, and when he suggested that he should return to continue his experiments at Small Heath, the company agreed once again to afford him the necessary facilities. Soon, with the help and advice of the company's experts, such progress had been made that the War Office again became interested. And anxious to become godfather of any successful new weapon—the B.S.A. claim to having "fathered" it could not be disputed—Whitehall made a grant in aid of continued research.

In a few months there was another demonstration at which B.S.A.'s original faith in the weapon was triumphantly vindicated. The projectile, fired from a specially adapted two-pounder gun, whipped through armour plating at a considerable range. Here at last was Britain's real answer to the Tiger tank.

The new projectile had a band or "skirting" near the middle, this skirting being flattened in its passage through a smooth-bore muzzle "squeeze" specially fitted to the gun barrel. Its armour piercing property lay in the high velocity thus obtained combined with its core of tungsten carbide, a material of extreme hardness which, in a different form, is used in the engineering industry for tool tips. Despite the fact that special plant was needed for its manufacture and that there was a great scarcity of the raw material, the Government decided that the performance of the projectile warranted the setting up of special tungsten factories.

By the middle of 1942 not only was the projectile for 2-pounder guns in full production at B.S.A. factories but the company's experts were busy designing projectiles on the same principle for 6- and 17-pounder guns.

It had been impossible for Janecek's father to conceal from the Germans the results of the earlier experimental work, and under Nazi supervision and direction the Czech engineers continued their researches. Although the Germans used a weapon based on the Janecek principle against the Russians in 1942, it soon disappeared, the reason being that the necessary supplies of tungsten could not be obtained from the Far East.

At an early stage in its development Britain imparted details of the new weapon to the United States and it was extensively used by the British and Americans in the D-Day operations. Carried in the light Tetrarch tanks of the Airborne Reconnaissance Regiment, the Littlejohn guns and projectiles, as they were officially known, were employed with excellent results against German self-propelled guns.

CHAPTER XX

ROCKET PROJECTILES

DESPITE considerable development on the Continent in the early '30s, it was Britain who first used rockets in the world war.

B.S.A.'s association with the rocket projectile goes back to 1936 when it lent to the Government Mr. F. W. Hulse, who had earlier relinquished the position of works manager to devote his whole energies to research in the Small Heath laboratories. He joined the scientists who, led by Sir Alwyne (then Dr.) Crow, Director of Ballistic Research, were already working at Woolwich Arsenal in an experimental department which was later to become known as the Projectile Development Establishment.

The rocket projectile had much to recommend it compared with the gun. Since its warhead did not have to withstand the shock of an initial propellent explosion or pass through a rifled barrel as in the case of a shell, it could be made of lighter material, weight for weight it could carry a very much greater explosive charge, and it was simpler and less costly to make. Moreover the launching apparatus needed none of the high precision manufacturing methods employed on a gun.

Mr. Hulse played a prominent part in the development of the new weapon. One of the principal problems had been to evolve a fuse which could be set to explode the main charge at a predetermined height. After more than a year's work he designed an aerodynamic fuse, which, with air

vents in the nose, was operated by the air pressure set up as the rocket sped to its operational height. But that was not all. He also originated the projector or "gun" of the early rockets consisting of a set of rails on a mounting which could be turned in any direction and raised or depressed to any elevation. The firing method was simple. Having set the fuse to the height indicated by the predictors, the "gunner" pressed a button which touched off electrically the propellent charge.

Throughout this experimental period Mr. Hulse, in addition to his research work, was acting as liaison between Woolwich and B.S.A., which was making the prototype components. The company's experts were constantly consulted on the manufacturing problems involved and there is no doubt but that their advice had a considerable influence in the design of the final model. Early in 1937 there began to arrive at Small Heath orders for components all under the part number "80—". They were known by various names such as "propeller shaft", "blade", "grid" or "contact screw", but such designations were meaningless to the operators making them and they were being manufactured in such small numbers by workers accustomed to thinking of components in terms of hundreds of thousands that they occasioned no special notice. They were "just another job" in a plant where there were thousands of jobs.

In the spring of 1940, after tests had been carried out in the greatest secrecy, the first projectiles were finally approved and orders were given for full production to start on both main types—those with propellent tubes two inches in diameter and those with three-inch tubes. With contracts suddenly pouring in for huge quantities of "80—" components it was not long before the B.S.A. workers began to

ask "What is it?" But their natural curiosity remained unsatisfied. It was a secret shared—and kept—by a few executives, draughtsmen, foremen and workers engaged in final assembly.

When the order for full production came the numbers needed were so vast that large orders were also placed with other manufacturers. It was here that the experience already gained by B.S.A. proved invaluable, for, despite the simplicity of the rocket principle some of the components were difficult from the production viewpoint This was particularly so in the case of the tube containing the propellent explosive, which had to be coated with special paint. So important was the thickness of this coating that the tubes were weighed before and after the operation to determine the amount of paint used, an amount which was only allowed to vary between infinitesimal limits. To do this a special spraying machine, mounted on rails and electrically timed was evolved at Small Heath and so successful did it prove that further models were made for the use of the other manufacturers engaged on rocket contracts. Another sphere in which the B.S.A. experts were able to give useful advice to the other firms was in the manufacture of the nozzles or "venturi", each of which involved no fewer than 14 cold-drawing, nine annealing, and 12 machining operations

Production was in full swing at Small Heath when the November air attacks came and the plant had to be dispersed, but a new home was soon found at Stafford, where the machines were restarted in January, 1941, full output being reached two months later.

By the time the contract was completed in the late spring of 1943, more than 350,000 three-inch and 360,000 two-inch projectiles had been delivered.

One of the earliest types, of which the company made nearly 30,000, was designed as a means of combating the dive-bomber, against which it achieved considerable success both on land and at sea Instead of the normal explosive charge the warhead consisted of a container into which were packed a large and a small parachute and two mines all attached to one another by lengths of piano wire. The rocket was fired in the path of the diving plane, and at a predetermined height the container released its contents. First emerged the small parachute and one of the mines followed by the larger parachute and the other mine, the two being separated by a long length of the wire. If the plane hit the wire one of two things happened: either a wing was shorn off or one or both the mines were precipitated against the fuselage of the aircraft, exploding on contact

At a very early stage in development the Air Ministry had been quick to realize the value of a rocket as a weapon particularly suited for attacking enemy armour and transport, while the Fleet Air Arm also saw in it a new means of destroying enemy convoys. Apart from its destructive capabilities, its great value in an aircraft was that there was no recoil, and consequently no loss of flying speed, which in the case of a long burst of machine gun or cannon fire might momentarily slow an aircraft by as much as 30 m.p.h. But all these were not the limits of use to which rocket projectiles were put, for specially built ships, capable of delivering broadsides of more than 500 rockets at a time, were used to wipe out coastal defences during the D-Day landings on the Cherbourg peninsula.

In a Government department at the end of the war there lay stored away some 6,000 projectiles of a type which, fortunately, never had to be used. The story of their manufacture began in the summer of 1942 when B.S.A. was asked to produce a rocket with a propellent tube five inches

◆ *HAD GERMANY USED GAS—These 5-inch rocket containers, made by B S A for the Government, would have been filled with liquid gas to enable Britain to retaliate had the Nazis started poison gas warfare*

in diameter and two feet long. In place of the normal warhead was a metal chamber about the same size as the tube. Plans were made to attain an output, if necessary, of 5,000 a week. It may be revealed that the metal chamber was to contain liquid gas of a type developed by a Scottish chemist and believed to be more deadly than anything known to the Germans. Thus was Britain prepared to retaliate if, as at one time seemed possible, the Nazis were intending to start gas warfare.

* * *

It was only natural that, side by side with the development of the rocket projectile prototypes at Small Heath, the

company should have also manufactured the experimental fuses for Mr. Hulse. The first order for operational supplies was received in June, 1940, and mass production started.

Fuse No. 700 was destined to become the company's stormy petrel of the war; certainly no other product became so travelled in the course of its manufacturing career. Its journeyings began within a few weeks of the start of production when the assembly shop was virtually destroyed in the August raid. The section had not long been reconstituted in another part of the Small Heath works when the machine shop at Daimlers, where the main components were now made, was damaged by bombs. Although production was not unduly delayed it was decided to prepare to duplicate the machinery both at Tyseley and at Redditch. It was as well this precaution was taken, for on November 14 came the Coventry blitz and the Daimler shop was further damaged. No time had been lost in preparing for production at Tyseley, which was able to start manufacture of the components within two days—on November 16. But the machines had only been running there three days when, in the November 19 raid, not only was Tyseley damaged but the reconstituted assembly shop at Small Heath was also hit. Again the whole job was moved, the machine shop to Redditch and the assembly and inspection sections to Monochrome at Redditch. But by the end of January it was on its journeyings again. Owing to pressure of space the two sections which had gone to Monochrome were brought back to Small Heath, where they remained until June, 1941. Then the whole job, machining, assembly, inspection and test, was dispatched to its final home in the dispersal unit at Tunstall.

One of the war products which caused most satisfaction at Small Heath—satisfaction from the personal as well as the company's point of view—was another fuse, the No. 117.

The personal satisfaction arose from the fact that in the preliminary discussions for its manufacture in March, 1936, there arose what was tantamount to a challenge to James Leek's engineering judgment. After examining the B.S.A. production scheme, War Office experts expressed doubt as to its success; and this opinion was conveyed in an official letter to the company.

Another letter followed asking whether, in view of this doubt, B.S.A. would guarantee the cost if it proved unsatisfactory? The directors were naturally concerned as the amount of money involved was very considerable, but they pinned their faith to the judgment of their own technicians. The guarantee was given and preparations made to start production. To say the manufacturing scheme was a success would be an understatement From the start it was a triumphant vindication of Leek's judgment and vision and later evoked the statement from Woolwich that the B S.A. fuses were "of the highest standard of manufacture now being produced" It was a graceful tribute coming, as it did, from a quarter which had originally been so sceptical.

But this is anticipating events for when the first fuses were produced in 1936 the regional Government inspectors refused to pass them. They criticised everything—even the colour of the varnish with which they had been coated. Such a position could not be tolerated for the fuses were up to specification in every respect. Eventually at the company's request a senior inspector came to Small Heath and after a complete re-examination passed every one of those which had previously been rejected.

CHAPTER XXI

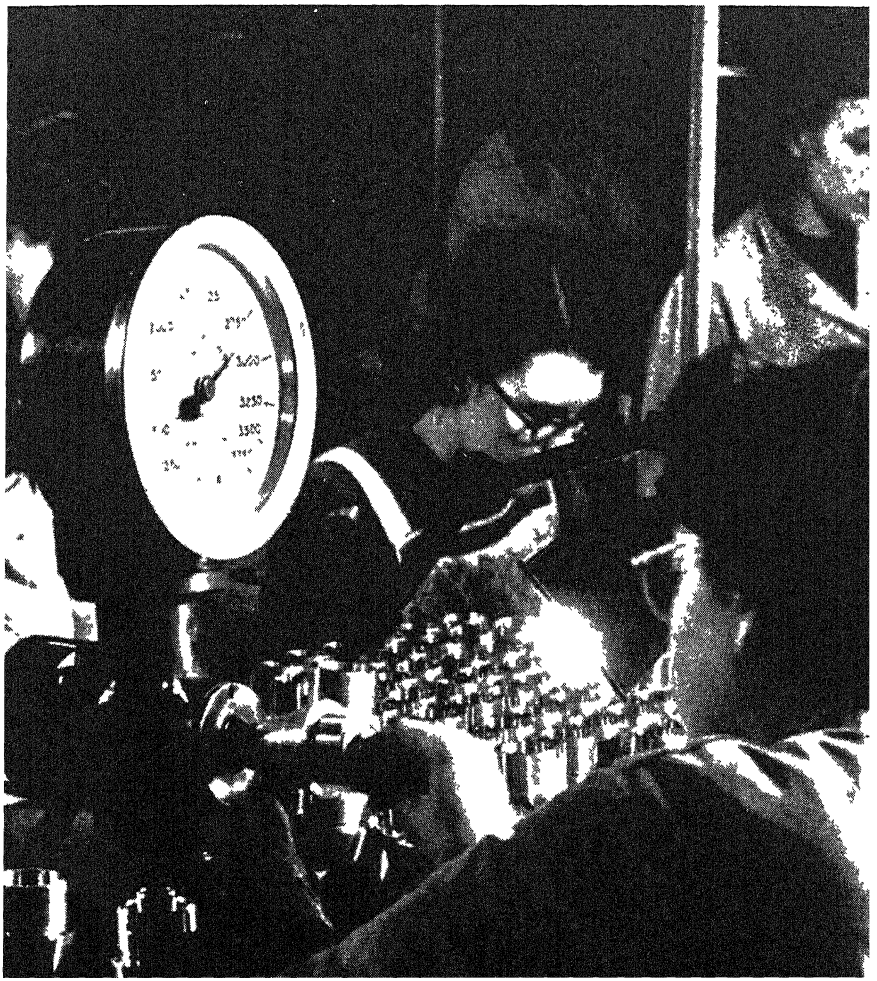
STEN SUB-MACHINE GUN

THE value of a tommy gun as a weapon for close warfare such as jungle or street fighting was realized both in America and in this country long before 1939. In fact it seemed so obvious that such a weapon would be needed in almost the same numbers as rifles that B.S.A. took up the licence to manufacture the famous Thompson sub-machine gun. But too many newspaper stories of the doings of Mr. Al Capone and too many films of the internecine "tommy gun" warfare of America's beer barons had blinded the War Office officials of those days to the fact that the sub-machine gun was indeed a weapon for soldiers. "We are gentlemen and we refuse to descend to gangster methods" was the attitude. So B.S.A. which had held the licence for seven years without producing a single weapon, packed up the models and returned them to the United States. So in 1939 the British Tommy "like a gentleman" went forth with a rifle to fight an enemy armed with automatic weapons.

In the latter part of 1940, after the experience of the German blitzkreig in France, the decision was made that should have been taken 10 years before: the automatic firepower of the British army would be increased by the introduction of sub-machine guns. An order was placed in America for Thompsons, but by the time the first few were delivered it was realized that not enough .45 ammunition could be made in this country in the time available. And with the U-boat war at its height the danger of losing a large proportion of the ammunition coming from the United States was acute.

The problem remained unsolved until officials at Woolwich had the excellent idea of making a 9 millimetre tommy gun, in which could be used the vast quantities of ammunition just captured from the Italians in Eritrea and Abyssinia —at that time it did not fit any of our existing small arms. The further advantage of having such a weapon was that this ammunition, whether foreign or made in this country, weighed less and could be loaded into a magazine containing 32 rounds, which compared favourably with the 20

◆ *Testing 117 fuses at 2,400 r p m for the correct opening of the shutter*



rounds and the extra weight of .45 bullets for the tommy gun.

Thus came into existence the 9 mm. Sten sub-machine gun, the "s" and "t" being the initials of the designers and the "en" standing for Enfield. It was modelled on a prototype German Schmeisser, but for the sake of speedy production most of the latter's refinements had had to be eliminated. From the point of view of a gunsmith it was a nightmare, but it could be made quickly and could do the job required of it more or less efficiently.

In July, 1941, B.S.A. was asked to quote for their manufacture and a few days later, after an official of the company had visited Enfield, a set of drawings and a sample gun arrived at Small Heath. On the same day verbal instructions came for the company to go into production at once and to have the first guns ready in five weeks.

Because no shop space was available at Small Heath, a temporary home was found in the rifle factory at Shirley, where a number of machines were "borrowed" to start the job. B.S.A. had agreed in the first place to make only three of the major components, the breech block, the barrel, and the body, and to undertake the assembly, the rest of the components being supplied as "free issue" from other contractors. But to give the Sten a good start it was found necessary in the case of the first few thousand guns to make every component requiring machining, almost everything, in fact, except pressed parts and a few pins and springs.

The job started in the middle of August and by the end of the month the first 25 guns had been made and delivered. This was made possible by the shifts on several occasions working right through the night without a break. During the initial rush—and for several months after—members of the staff used their own cars to collect from the contractors

small batches of components at a time as and when they were finished.

From the first the popularity of the tommy gun appeared to have a psychological effect on the other Sten contractors, all of whom showed the utmost anxiety to get into production. But as most of the regular engineering firms were already working to capacity, substitutes in other trades had to be found. As a result firms which in peacetime were engaged in making cheap jewellery, lawn mowers, ironmongery and children's scooters found themselves making Sten parts. Even the engineering department of a brewery was pressed into service to make certain parts.

At first there were the usual teething troubles. Owing to the urgency of the job and the lack of proper gauges many components received from the other contractors had to be rectified on arrival. But all this was put right after a few weeks.

While the first guns were being made at Shirley, a new home for the Sten was being prepared at Tyseley, and in September the job was moved there in its entirety. The production figure for that month was 200, followed by 1,000 in October and 2,000 in November. By July, 1942, when the 100,000th gun was dispatched, the output had risen to more than 20,000 a month and by the end of the year it had topped the 25,000 mark. Such figures give a production curve which delights the heart of an engineer. By the time the contract came to an end more than 400,000 complete guns had been dispatched together with just on 350,000 spare barrels.

Even though the Sten was a crude weapon B.S.A. put much more into it in the way of engineering refinement than the specification called for and many special orders were received. On one occasion, after the company had supplied 600 for such an order, there came a letter of congratulation from Whitehall stating that throughout the Commando operation on which they had been used there had not been one stoppage.

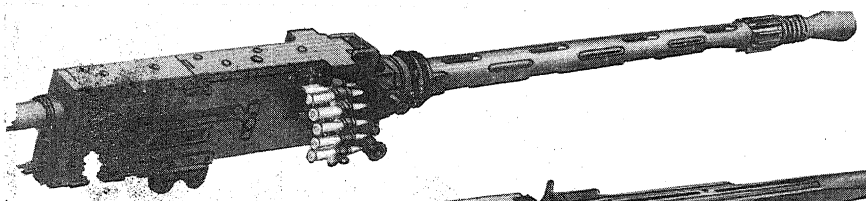
CHAPTER XXII

B.S.A. — DAIMLER SCOUT RECONNAISSANCE CAR

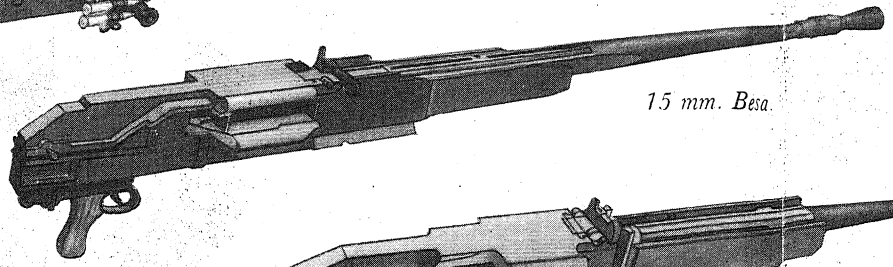
THE most successful fighting vehicles of their class used by the Allied armies during the war, the B.S.A. Daimler Scout and its later and heavier edition, the Daimler Mark I Armoured Car, were the direct result of many months' work in the design department at Small Heath. And the basic soundness of the original conception was proved by the fact that throughout the six years of their successful employment in all theatres of operations not a single major modification had to be introduced.

Work on the plans for a prototype began very early in 1938; as soon, in fact, as it was learned that the War Office would be interested in suggestions for such a vehicle. At that time the German Army was developing for reconnaissance purposes a most elaborate and complicated motor cycle combination, which mounted a machine-gun and in which both driver and gunner were afforded a measure of armoured protection. It was decided, however, that the British Army would require a more robust vehicle, which could traverse terrain over which a motor cycle could not pass.

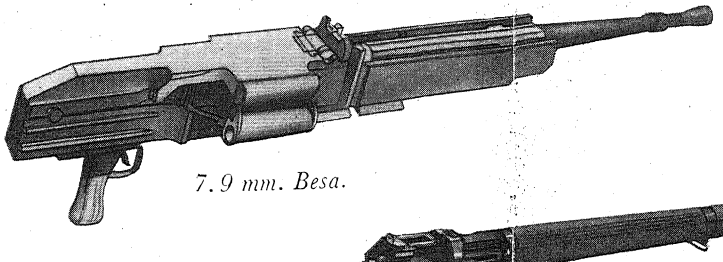
The Small Heath designer entrusted with the task set out to evolve a car which would carry a crew of two and in which one or more machine guns could be mounted. Within a few weeks they had completed the preliminary drawings, which were taken to Brigadier (then Captain) W. Blagden at the War Office's Wheeled Vehicles Experimental Department at Farnborough. Brigadier Blagden, who had been kept informed of progress almost from the start, was extremely



.303 Browning Gun.



15 mm. Besa.



7.9 mm. Besa.

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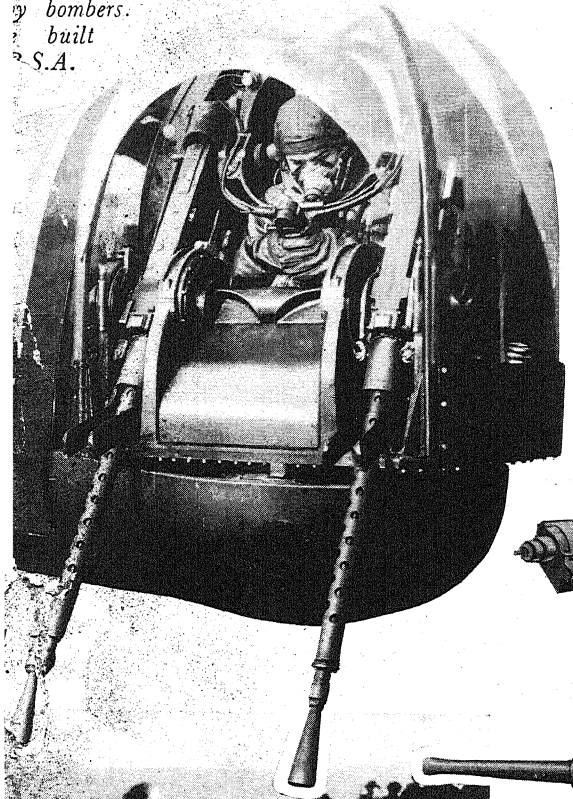
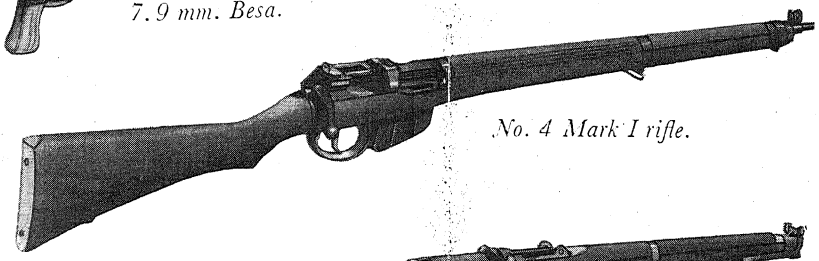
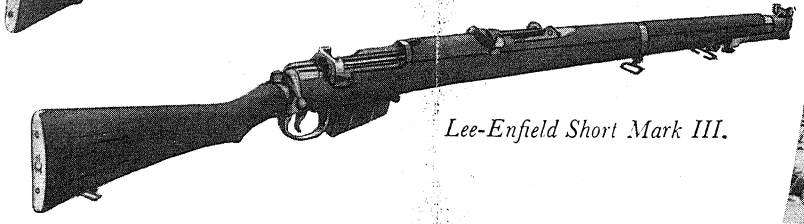
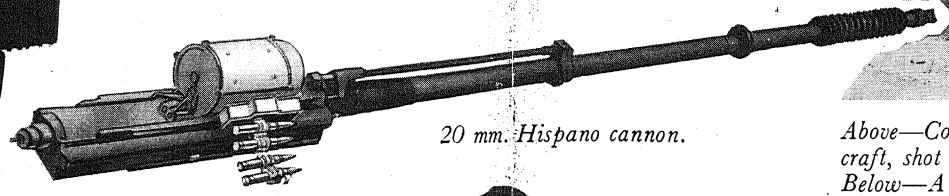




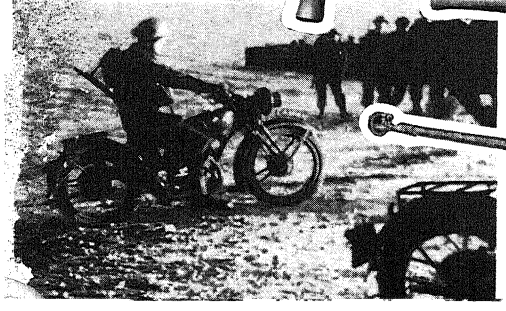
No. 4 Mark I rifle.

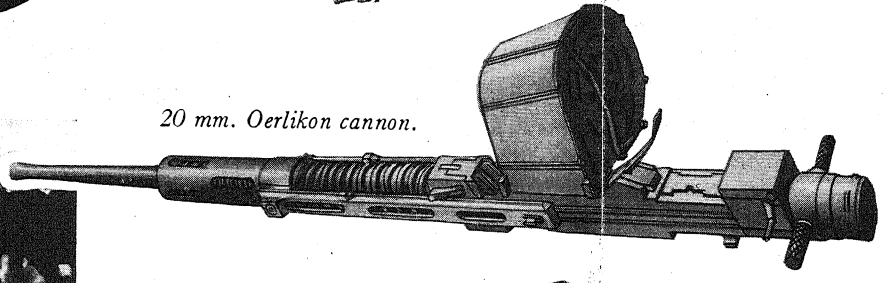


Lee-Enfield Short Mark III.

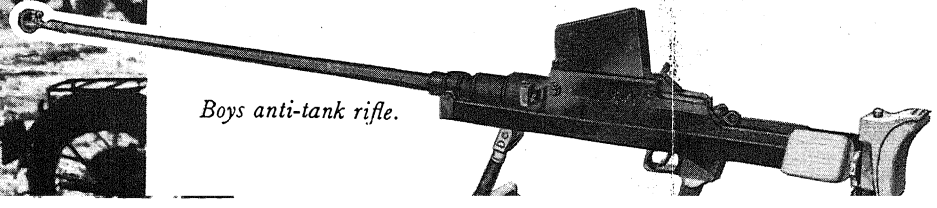


20 mm. Hispano cannon.

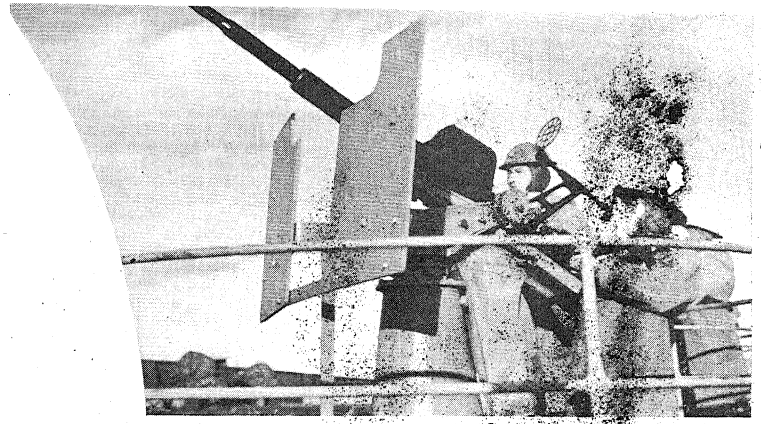




20 mm. Oerlikon cannon.

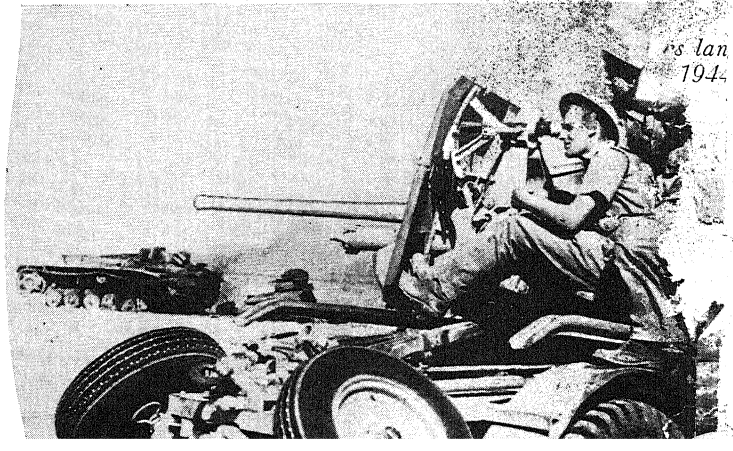


Boys anti-tank rifle.



Oerlikon guns played a vital part in the defence of convoys. Here an Oerlikon crew aboard a cruiser stand by at action stations as she nears the Norwegian coast.

Above—Corner of a Battle of Britain graveyard of German aircraft, shot down by R.A.F. fighters armed with .303 Brownings. Below—A two-pounder battery halts enemy armour at Alamein.



WEAPONS OF VICTORY

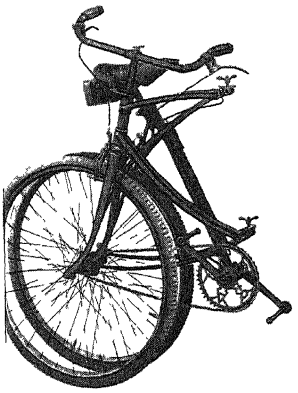
More than 5,000,000,000 munitions components were made by B S A Guns Ltd and B S A Cycles Ltd for the battle against the Axis—an average of 1,650 pieces every minute day and night throughout the war

Under Small Heath control were 67 establishments, with 3,671,376 square feet of floor space, 28,000 employees and 25,000 machine tools

Among the principal munitions manufactured were:—

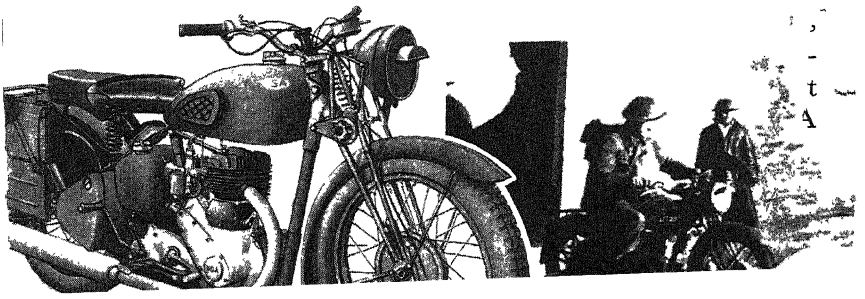
303 Browning aircraft machine guns 20 mm Hispano cannon magazines and continuous feed mechanism 20 mm Oerlikon cannon and magazines, 15 mm and 7 9 Besa machine guns and ammunition belts Boys anti-tank rifles and magazines Lee-Enfield Short Mark III and No 4 Mark I rifles and magazines, Sten carbines, 20 mm Polsten cannon barrels and magazines two-pounder gun carriages, Bren gun magazines, bipods, tripods and butts, fuses for shells, bombs and rockets, Bofors loading mechanism, smoke dischargers, Welrod silent weapons, electrical generating and charging sets, rocket projectiles, 6-pounder rear lifting gear and ammunition hoppers

Military motor-cycles, cycles and paratroop folding cycles, high velocity projectiles, gun trundles, gun sights, mountings and hydraulic gear for 2-gun bomber turrets blades for jet-propulsion aircraft engines, Lewis gun barrels and magazines, 40 mm shells



B S A folding army bicycle

Army motor cyclists on B S A machines land on the Normandy beaches on D-Day, 194-



interested in the lines of the proposed car and, after studying the drawings with his fellow experts, made several practical suggestions for improving the lay-out. So valuable were his contributions over the next few weeks, in fact, that he might almost be said to have been the co-designer of the car.

By the beginning of May the plans were complete, but before submitting them formally to the Mechanization Board at Woolwich Arsenal they were shown to a number of officers at the War Office. There was immediate enthusiasm since the proposed vehicle was far in advance of anything they had yet seen or even contemplated. Its chief features included four-wheel drive from a central differential, fluid flywheel transmission from a 2½-litre Daimler engine, independent four-wheel suspension, a speed of 60 miles an hour in a forward gear and 55 miles an hour in reverse, and a special arrangement for steering in reverse by the rear wheels. In addition the car was well under five feet high, thus presenting a minimum target to an enemy, while an angling of the seven millimetre armour-plating gave the two occupants of the turret a protection equal to that normally accorded by plating of double the thickness. The officers declared it "a most excellent vehicle" and signified their intention of recommending that an order be given for a prototype to be manufactured.

At this point it became necessary for the Small Heath management to consider how best to arrange mass production of the vehicle were a contract placed. Every available square foot of shop space was taken up with Browning Gun and other armament production, while the new Redditch factory was being built primarily to enable the Besas to be manufactured. From the tense international situation it was obvious that if the War Office chose the B.S.A. vehicle—two other companies had already submitted models—it would be needed very quickly in considerable numbers. A

happy solution of the problem was found within the B.S.A. group, for the Daimler Company, which in any case would have had to supply the engines, agreed to take over not only the construction of a prototype were one required but the building of all vehicles which subsequently might be ordered.

In June the War Office asked for (and subsequently accepted) a tender for a car, which was constructed at Coventry and delivered to Farnborough in September to undergo its tests, which included a 10,000 mile trial. From these it emerged triumphant and, after minor modifications had been incorporated, it was demonstrated to members of the Imperial General Staff in January, 1939. Following this an order was received for 500 Scouts.

While this work was proceeding Diamler designers were developing from the Scout the Mark I Armoured Car, which carried a crew of three. An additional feature of the bigger vehicle was the introduction of a second steering wheel for use when the car was being driven in reverse.

Although at that time it was impossible to envisage a major desert war, the two vehicles might almost have been specially designed for the North African campaign in which they proved themselves capable, as one Eighth Army officer put it, of "skating over treacherous soft sand on their bellies". Such was their reliability that Field-Marshal Rommel chose a captured Scout to escape after Field-Marshal Montgomery had inflicted a decisive defeat on the Afrika Korps at El Alamein.

CHAPTER XXIII

RUSH JOBS — AND OTHERS

SPECIAL weapons for Resistance Forces in Europe, R.A.F. bomber turrets, shell cases, gun carriages, field gun trundlers—these and a host of other munitions were manufactured by B.S.A. during the war in addition to the armaments already described.

One of the most deadly weapons used by members of the French Resistance Movement against the occupying German forces in the months before D-day was manufactured at Small Heath. This was the Welrod Silent Pistol.

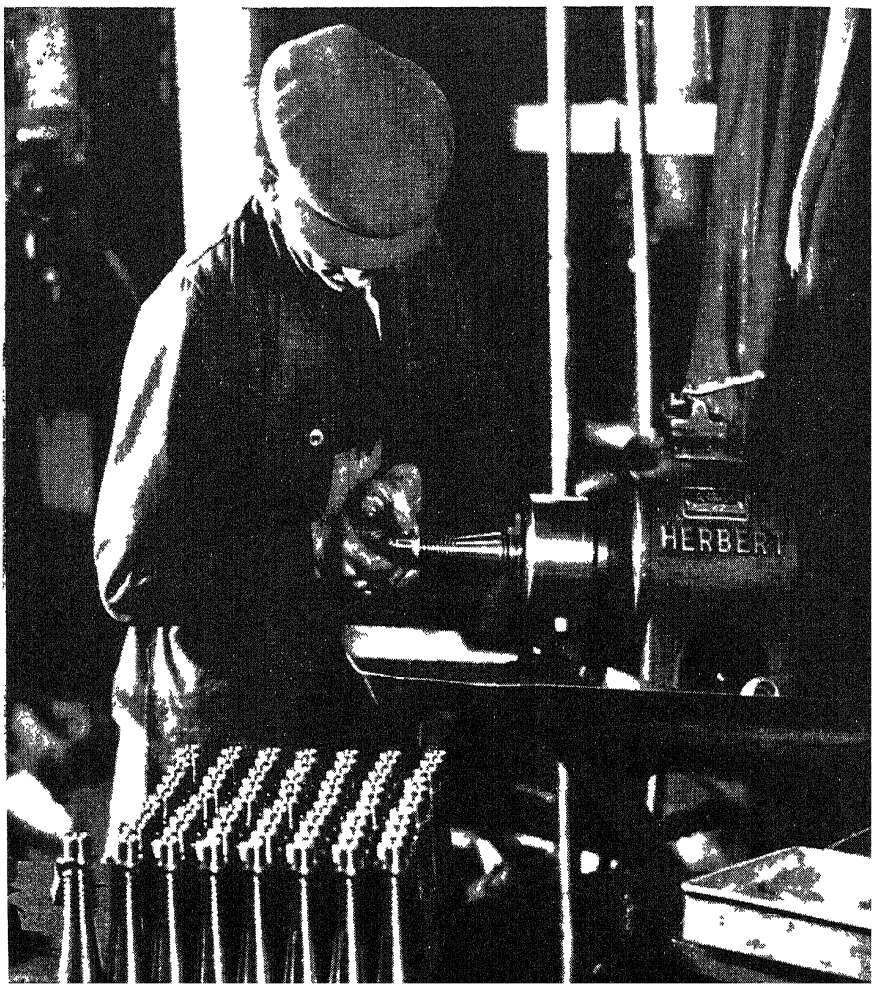
Although from 1942 onwards the French were receiving regular supplies of normal military arms and ammunition dropped at night by parachute from R.A.F. planes, these were only of use in regular warfare. There was an obvious need for a weapon with which the war of nerves could be carried into the dance halls and cafés frequented by German officers and men; and it had to be a weapon which would give the user a chance to escape after an "execution".

Late in 1943 the War Office asked B.S.A. to manufacture a pistol, which had been specially designed by an army major. In the matter of silence it was the most perfect gun of its kind ever evolved, for when the tip of the muzzle was pressed into a sandbag and a shot fired, there was only the faintest noise, which would pass unnoticed in the normal chatter and clatter of a café. To enable it to be manufactured quickly on the large scale required, the company's experts simplified the design. Within six weeks the first batch was on its way to France, and with them a new reign of terror was instituted against the men who were shooting hostages

by the score and wiping out whole villages just as they had earlier exterminated Lidice in Czechoslovakia.

In addition to the manufacture of barrels for all the complete weapons it was manufacturing, B.S.A. also made many hundreds of thousands for other guns, including those for the Navy's 40-millimetre 2-pounder anti-aircraft guns (the famous "Chicago Pianos"); for the Polsten cannon; for the Hefah machine gun, used in light coastal craft at

◆ *Polishing Browning gun flash eliminators before they were chrome plated to prevent fouling*



one period of the war; for the Admiralty's Lanchester 9-millimetre sub-machine gun; and also for the 40-millimetre "tank-busting" gun, first mounted in aircraft operating in front of the Mareth line in North Africa.

There can have been few Brens used during the war which did not have some part of them manufactured by B.S.A., which sent to the assembly shops of the Royal Ordnance factories more than 4,000,000 major components, including tripods, bipods, and magazines, together with vast quantities of springs, stampings, and smaller components.

In connection with Bren parts, B.S.A. received on D-day a very urgent inquiry from the War Office for a number of folding tripods for the use of paratroops. The first 50 had to be ready within a week. On June 7 a model was received at Small Heath, and by dint of working day and night and throughout the week-end 57 were completed, inspected and delivered by June 12.

Time and again there were similar rush jobs. In fact, Government departments quickly realized that B.S.A. would always come to their rescue in emergency. And such emergencies were always arising.

Typical was the case of a wheeled trundler to enable troops to man-handle the new 3.47 field gun through Burma's jungle trails and mountain tracks, which neither motor nor mule could negotiate. On June 8, 1945, the drawings were received at Small Heath with the request that the first trundler should be ready within four weeks. Despite many mechanical difficulties it was ready at the end of the third week; by the fifth week five had been finished and production was getting into its stride.

Sometimes it was a question of making a small but nevertheless vital component needed immediately in one of the theatres of war. In 1941, for instance, the company was asked whether it could manufacture within a matter of days 500 trip levers and sockets for the firing mechanism of

Browning guns fitted to fighters operating in the desert. And with the inquiry came the information that a plane was standing by to fly them to the Middle East. The only way in which they could be produced in the time was to give the job to the tool room and there, with a few samples turned out by the experimental department as a guide, each of the 500 sets was made separately by hand. Again it was a question of working day and night, but within three days the first 200 were delivered and on their way to Libya.

Their manufacture is an example of the difference in cost between a mass-produced article and one laboriously made by hand. Had these parts come from a "production line" their cost would have been 1/6 each, perhaps even less; but made individually as they were in the tool room the bill for labour alone for each set was more than 20 shillings.

It was in the same year there arrived at Small Heath one day a Ministry of Supply official with a very urgent request. Could B.S.A. manufacture at once steel punches for pressing down the detonator charge in cartridge filling machines? Premature explosions of the charge (which ruined the tool but which were not powerful enough to endanger the operator) were so frequent that the normal suppliers of the punches could not keep pace with the demand. In view of the urgency B.S.A. agreed and within seven days the first batch was on its way to the ammunition filling factories.

It will probably surprise many people to learn that the Lewis gun, the Great War weapon, was also employed in considerable numbers in the early part of the world war. In 1938 the War Office, making its first inquiry about Lewis guns for nearly 20 years, asked B.S.A. to make serviceable the considerable stock of guns in the Government Ordnance stores and to convert more than 50,000 of the air model Lewis gun—it was a dual purpose machine in the Great War—into the land type. In addition to carrying out this

work the company made a large quantity of spares, including nearly 200,000 magazines.

B.S.A. was also intimately connected with the 40-millimetre Bofors anti-aircraft guns, which played such a prominent part in the defence of London against the Luftwaffe in 1940 and 1941. It was in December, 1938, when armament work was piling up in no uncertain fashion at Small Heath, that the Director-General of Ordnance Factories inquired whether the company would undertake the manufacture of the Bofors loading mechanism. James Leek visited a Government factory at Nottingham, examined the feed and within 24 hours sent a quotation for its manufacture to London. Before the end of the month his price was accepted

With all the armament orders already on hand at that time—apart from civilian productions of cars, motor cycles and cycles — the departmental managers were alarmed. They came in a deputation protesting that the factories had already more work than they could properly undertake: "If you give us any more we will come to a standstill." (Not all of them were convinced at that time that war was inevitable and little did they dream that this was a mere flea-bite compared with the problems they would be facing—and overcoming—within a few months.)

James Leek was polite but firm with the deputation. He knew the vital need for arming. "We are going ahead with the manufacture of the loading mechanism", was his answer. And to warn them what to expect in the future, he added, as a parting shot: "We shall be taking on other new weapons shortly".

And this was the case throughout the battle against the Axis—a never-ending stream of new articles of war to be manufactured for Britain and her allies.

CHAPTER XXIV

RESEARCH AND DESIGN

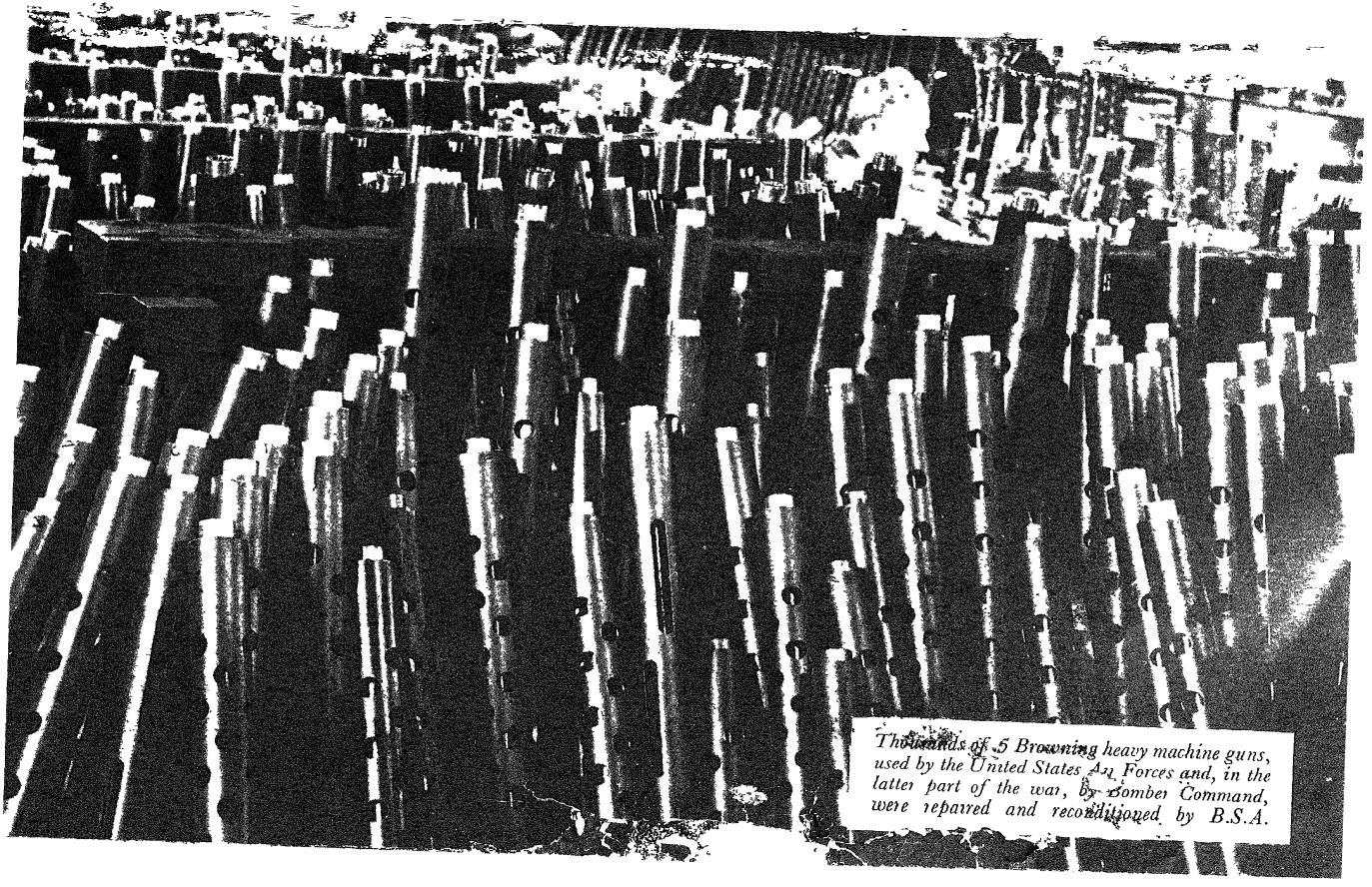
TO the band of chemists and physicists working in the laboratories of Small Heath in the late '30s the rumours of war and the war itself came as a challenge. Their task was not only to seek knowledge but, what was sometimes infinitely more difficult, to apply that knowledge, once gained, to the practical problems of armament production. It could not be a quiet, patient seeking after truth; it had to be a grim race against time.

There was no narrow selfishness about discoveries. Britain was at war and any firm whose products could be improved or whose output could be increased by the results of B.S.A. research was given the fullest help.

One of the most important and fruitful fields of investigation by B.S.A. was the application of hard chromium plating direct to all types of ferrous and non-ferrous metals, including aluminium alloys, to provide surfaces which would resist wear and corrosion.

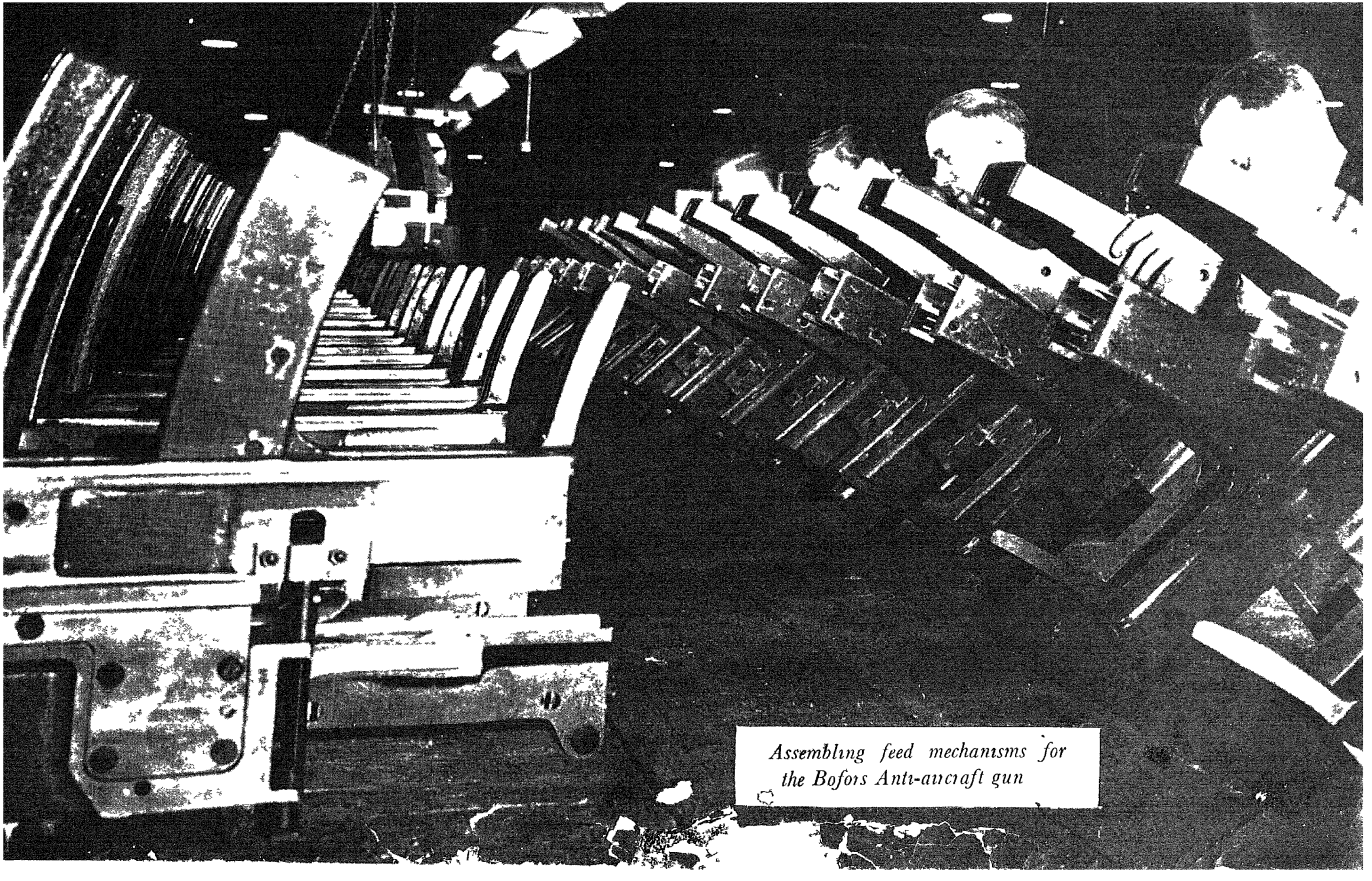
This research began with the solution of an early Browning gun problem when it was found that the action was being slowed by fouling. Many remedies were sought but none discovered until it was decided to try plating with hard chromium the muzzle end of the barrel and the muzzle attachment through which the barrel worked. The experiment, carried out in a small enamelled iron tank with a car accumulator providing the current, proved instantly successful.

Rolls Royce were immediately interested since the problem of valve rocker wear in their aircraft engines had been exercising the minds of their experts for some time. Hard



Thousands of .5 Browning heavy machine guns, used by the United States Air Forces and, in the latter part of the war, by Bomber Command, were repaired and reconditioned by B.S.A.

Assembly of the Sten before final inspection.



Assembling feed mechanisms for the Bofors Anti-aircraft gun

Most skilled operation in small arms production—hand "setting" of barrels

chromium plating was again the solution and thenceforward all valve rockers for their Merlin and other engines were treated in the works of Monochrome Ltd. Loading trays for the Bofors gun were plated in the cartridge recess, a process which not only prevented wear and corrosion but permitted the employment of types of steel in more plentiful supply than the stainless steel originally specified. Throughout the war the tubular members of aircraft retractable undercarriages were plated. The life of gauges, drawing dies and general tools was increased fivefold compared with standard tools.

Invaluable assistance was also given to many firms in salvaging complex components inadvertently machined undersize. By building them up with hard chrome they could be re-machined to the correct sizes, thus saving thousands of invaluable man-hours.

In dealing with all this work on mass production lines much was learned in the way of designing rapid-action jigs and of plating technique by which deposits of accurate thickness and maximum adhesion were obtained The rapidity of barrel wear was from the start one of the chief problems facing the American manufacturers of the heavier .5 Brownings favoured by the United States Air Forces and adopted in the latter part of the war to a certain extent by the R.A.F. in Lancasters and other heavy bombers. Eventually there was evolved at the Monochrome works a method of plating with such precision that the entire rifling could be given a hard chrome surface, thus considerably extending the life of the barrel.

With the advance of the science of war new problems arose in the design and manufacture of springs for aero engines and automatic guns working at much greater speeds. At these speeds surface stresses in the springs were considerably increased and were the cause of frequent failures

in the wire. In heat treatment operations the carbon content of spring wire is almost inevitably reduced through oxidation in the surface layers, thus lowering the strength proportionately. After lengthy investigation to discover how these surfaces could be treated to offer greater resistance to this fatigue, it was found that very great improvement was obtained by bombarding them with steel shot at high speed.

Springs also failed through corrosion weakening the surface layers, but it was found that failures from this cause were reduced to a negligible number when the surface of the steel was changed by special treatment to a complex phosphate of manganese and iron. This process was afterwards applied in various other ways—to prevent fretting in parts of mechanisms which rubbed together under heavy pressure, such as gun locks, and to deep drawing tools, the lives of which were greatly prolonged with a consequent improvement in production.

The process was very simple in application since the articles had only to be degreased and immersed in a hot chemical solution to effect the change to phosphate. And the surface coating so produced not only acted as an insulator but it also absorbed oil or grease, thus providing an additional guard against fretting.

Another major problem investigated at Small Heath was of peculiar interest to the company as gun manufacturers. One of the chief difficulties in the production of gun barrels is that of keeping them straight through all the various machining operations. Modern barrels have to be made in high tensile steel and the necessary mechanical properties can only be obtained by heating the barrel blanks to a high temperature and cooling them rapidly in oil, followed by a second heating to a lower temperature to give the required temper. Unless handled in a special manner during this heat treatment the barrels tend to bend badly and have to

be cold straightened, a process which locks up in the surface layers stresses which may be released in subsequent machining operations. The effect of their release may cause the barrels to assume their original shape, thus making further setting necessary with consequent hindrance to production. To avoid this bending during heat treatment, experiments were made with a specially designed furnace, which permitted the barrels to be suspended vertically throughout the operation. They proved entirely successful and thus was eliminated to a considerable extent the need for setting, always a long and costly operation.

New methods by which time and materials could be saved were always being introduced. One of the most valuable of these, coming as it did at a period when every round of ammunition was urgently needed, resulted in the substitution of electrical timing in Browning gun speed tests for the previous stopwatch method. Not only was the electrical method accurate but only ten rounds of ammunition were needed for each weapon where 40 had previously been used—a saving of 150,000 rounds a week at the peak period of production. The method was immediately extended to the testing of all the company's automatic weapons.

All these investigations—and a hundred and one others besides—were carried on side by side with the routine activities of an engineering company's chemical laboratories, where samples of every consignment of raw material delivered at the factory were analysed before being released to the workshops—a necessary precaution in view of the danger of a component being fashioned from the wrong type of steel or other metal. It was obviously impossible to test each individual bar or rod of every consignment. This would have needed an army of chemists. The system was to choose a dozen or more bars at random and if these

proved to be of the correct specification the whole batch would be passed, the end of each bar being painted with a particular colour to indicate the type of steel. If, however, even one sample were found incorrect the whole consignment would be returned to the suppliers. Sometimes the need for the raw material was so great, however, that to save time it would be decided to have every bar analysed in the company's own laboratories. One such case will long be remembered for the work it involved. From a load of 600 bars of steel urgently needed in a Browning gun shop 12 were duly selected and tested. Two of them were of the wrong type. There was nothing for it but to test them all. Twenty-four hours later the task had been completed. Of the 600 bars 597 were according to specification, three were wrong. Such was the luck of the random draw.

* * *

The Battle of Production throughout the war was so essentially a battle of man-hours that considerable time was devoted by the company's designers to evolving weapons which, while as efficient as guns already being manufactured, could be made more quickly.

The Oerlikon constituted a case in point. It was neither an easy nor cheap weapon to manufacture and even before it was in production, Government designers had evolved a substitute gun, the Polsten. It was learned at Small Heath that there was official dissatisfaction with the performance of the first models of the new gun, and at this juncture B.S.A. experts decided to take a hand. After two months' intensive work they produced a 20 millimetre anti-aircraft cannon, the Lekon, which on the company's ranges proved itself at least the equal of the Oerlikon in performance. Not only did it use the same type of ammunition but from the maintenance viewpoint it possessed many advantages, chief of which was the fact that the reciprocating mechanism

instead of being outside the gun was totally enclosed in the casing as one big block. In addition certain ejection troubles of the Oerlikon had been eliminated by the introduction of a spring-loaded cartridge support.

In the matter of manufacture the difference between the three weapons was more than striking; in fact the Lekon was described by the B.S.A. officials in charge of the output of comparable weapons such as the Hispano and Oerlikon as the "production manager's dream". The difference in the man-hours required to produce the three guns, as estimated in 1942, was:—

Lekon - 70 Polsten - 110 Oerlikon - 130

Striking as were these figures—and the Government Ordnance experts did not stint its praise of the weapon—the Lekon was never put into production since by the time it was ready the Ministry of Supply was committed to the Polsten and had ordered all the machinery necessary for its manufacture.

For much the same reason the Government failed to adopt another B.S.A. gun, the Besal .303 machine gun, which could be manufactured in half the man-hours required for a Bren.

After various modifications had been introduced to bring it into line with official requirements, the prototype was sent to Pendine, where it passed with complete success the most exhaustive tests to which a machine gun had yet been subjected. It was officially approved and accepted for service in February, 1943, but no orders were received, owing, it was understood, to the large stocks of Brens already in existence.

Early in 1944 the Ordnance Board decided that the time had come to replace the Sten with a true precision weapon and a number of firms submitted designs. One of the principal specifications was that the rate of fire must not

exceed 500 rounds a minute (the problem in an infantry automatic weapon is to slow down, not increase, the speed of fire). The first model produced by B.S.A. had a rate of fire of 450 rounds a minute. Had speed been the only criterion the contest would have been over then and there for none of the guns entered by other firms and designers conformed to this specification. To enable competition to continue, however, the permissible rate of fire was increased to a maximum 600 rounds a minute and B.S.A. accordingly altered their design to allow an increase to 530 rounds a minute.

With its ultra short barrel—the length of the whole weapon with the butt folded was only 19 inches—it was considered at the preliminary tests that it would not have the accuracy of longer barrelled weapons. But this natural supposition was promptly disproved by the B.S.A. marksman, a Bisley veteran, who on automatic fire at 100 yards put a burst of five shots in a 3 inches by 2 inches rectangle in the centre of the foot square target. So astounded were the officers present that the first report from the butts had to be confirmed before they would believe it.

CHAPTER XXV

THE TWO INSPECTORATES

THE inspection of 2,000,000 precision components a day, the average B.S.A. output throughout the war in Europe, was a most formidable task, and but for the high degree of co-operation which came to exist between the two "views"—the company's inspectorate and those of the various Government departments—it would have been impossible to have maintained the ever-increasing flow of arms demanded by the Fighting Services.

The organization of the company's inspectorate, which at the peak of production consisted of more than 2,500 men and women, was in itself an achievement since all but a comparative handful had first to be taught the use of gauges, micrometers and all manner of other precision instruments in a special "school" at Small Heath. The trainees were to a certain extent the cream of the recruits to the munitions front and it was, therefore, all the more galling in the early days of the war to find that many of them, once proficient, were lured away from the company by the inflated war bonuses then being offered in certain other factories. No fewer than 75 men and women were lost in this manner within six months and the problem was only solved in May, 1940, by the "stand-still" regulation issued under the Emergency Powers Act.

Because of the diversity of the war weapons it was manufacturing, no other engineering company in the country had a wider experience of official inspection than B.S.A. At one time or other—sometimes all together—no fewer than seven Government inspectorates or sub-inspectorates had

staffs working in the firm's factories and dispersal units. These were:—

ADMIRALTY—Inspector of Naval Ordnance (I.N.O.) and Ship Fittings Overseer.

WAR OFFICE and MINISTRY OF SUPPLY—Chief Inspector of Armaments (C.I.A.) with C.I.A. (Ammunition) and C.I.A. (Carriages); and Chief Inspector of Electrical and Mechanical Equipment.

MINISTRY OF AIRCRAFT PRODUCTION—Aeronautical Inspection Department (A.I.D.), the work of which was largely carried out until 1940 by the Small Arms Inspection Department of Enfield.

At the beginning of the war the Government inspectors were, perhaps naturally, inclined to adopt too rigid an attitude; it took them time to appreciate the fact that B.S.A. and the other great engineering firms, in addition to their vast knowledge of high precision manufacturing methods, were often better acquainted with what was really needed in the finished product than the inspectorate. One of the most notable examples of this occurred in the manufacture of the Browning gun when the Government inspectors found that B.S.A. was working to within much finer limits on certain parts than called for by the specifications. Had the company followed the blueprints provided—as it was entitled to—the gun would have been prone to seizure, but the company knew the weapon too well to allow such errors to creep into its manufacture. This incident, in fact, led to the Small Heath experts drawing up a new list of the tolerances which could be allowed on each Browning gun component, a list which was adopted immediately by the Ministry.

If, however, Government specifications sometimes erred on the side of indulgence, at others they called for components to be made within what manufacturers considered to be needlessly narrow limits. An instance of this was the Oerlikon's 20-inch main spring, the top of which, according

to the Admiralty drawings, must not be more than one-eighth of an inch out of the perpendicular. Although it was pointed out that even after the first trial shot it might be half an inch out of true and would still be 100 per cent efficient, it proved impossible to get the permissible tolerance altered. It was not only that manufacturing difficulties were naturally increased by this rigidity but also that the springs once made had to be handled and packed as if they were pieces of rare porcelain. The degree of care necessary can be appreciated when it is realized that were one to fall on its side, the impact would often cause enough distortion for it to be rejected. The result was a brake on production at a time when the guns were most urgently needed.

Although both inspectorates were working with identity of purpose—to obtain maximum armament output—such differences of opinion were perhaps inevitable.

The ceaseless nerve strain of striving to increase production made any relief welcome and no one could blame the company's inspectors if, on occasion, they obtained a sense of satisfaction from a sly, but withal friendly, dig at a Government department. One such opportunity presented itself in connection with the Oerlikon springs when a consignment of 15,000 of various sizes was returned by the Admiralty to Small Heath on the grounds that they were not up to specification. Although none of the firms supplying springs was allowed to stamp them in any way—such marks might set up fatigue fractures—B.S.A. was able to state immediately that none of the consignment had been supplied by the company.

"How do you know?" was the natural question.

"Because", came the rejoinder, "all these springs have left-hand winding while all B.S.A.'s have right-hand winding."

There were many pitfalls for a munitions manufacturer using components supplied by outside makers and in this connection the system adopted by the Royal Ordnance factories was incomprehensible. Although stampings had passed the Government inspection department before being dispatched the certificate accompanying them specifically stated that no guarantee was given as to size! Only once did B.S.A. fall into the trap. This was early in the war when machining was begun on a large quantity of Government-made stampings. Thousands of man-hours were expended before it was discovered that the stampings did not conform to specification and that, in fact, the whole consignment should have been scrapped at source. The result was the immediate institution by B.S.A. of a 100 per cent inspection of all components entering the works from outside sources before they were released to the machine or assembly shops.

If there is one main criticism to be made of the inspection system as it existed in this country throughout the war, it lies in the fact that labour was not used in all cases in the most economical manner and, even more so, in the unnecessary duplication of effort.

As regards the uneconomical use of labour, this took place in the department of the C.I.A. through a rule which prevented any woman employee from using a precision instrument; their activities had to be confined to simple gauge work. Thus a considerable body of men, who would have been better employed in actual production, were tied to the "viewing" benches. The rule, which applied only to C.I.A. and to none of the other Government inspectorates, was the result of an agreement with the Amalgamated Engineering Union and was adhered to throughout the war. It led not only to anomalies—an I.N.O. woman "viewer" would be using a micrometer while in an adjacent C.I.A. section an almost identical job had to be handled by a man—

but also to delay in the delivery of weapons. On frequent occasions there would be insufficient numbers of men to handle a rush job requiring the use of the simplest instruments of precision. But the women had to sit idle while the available men plodded along. This rule was particularly unfortunate in the case of very small components which women, with their nimble fingers used to needlework, could have handled very much more quickly than men.

The Ministry of Labour was constantly trying to find means of introducing more female labour into factories and to this end an official on one occasion visited a B.S.A. plant. As he toured the various shops he came to a section in which men predominated.

"Couldn't women do all this work?" he asked.

"Easily," was the reply, "but these men are inspectors—Government inspectors!"

This C.I.A. rule was not so wasteful of labour as was the duplication of effort in inspection by which a 100 per cent "view" by a firm was followed by a similarly thorough official inspection. The Ministry of Aircraft Production, alone of all the Government departments, departed from tradition and instituted a more economic scheme. Under this there was only a single 100 per cent inspection—that carried out by a company's "viewer", all of whom had been individually approved by the Ministry. To keep a check on their work, a right and proper procedure, A.I.D. officials tested a small percentage of each batch of passed components.

Had the other Government departments adopted this scheme, which functioned smoothly from its inception, a considerable labour force would have been released. In the case of B.S.A. it would have freed some 1,000 workers out of a total of 4,000 employed in the combined "views".

CHAPTER XXVI

A UNITED FRONT

IN assessing in the late '30s Britain's capability of waging a major war, the Nazi rulers of Germany made three gross errors, errors which were to cost them their dream of world domination.

The first was in underestimating the fighting power of the Royal Air Force.

The second was the conclusion that Britain could not mobilise her industries for maximum munition production in the time which the German Blitzkrieg plan would allow her.

The third error was the belief that, even if her industries were mobilised in time, sufficient war production could not be obtained without the rigid regimentation of workers such as had existed in the Third Reich since the advent of National Socialism.

So Germany made her mistakes and found herself fighting a Britain suddenly and, according to Nazi calculations, impossibly united. It was the unity which can only come to a free people in the hour of peril when, with one accord, differences of thought, opinion, and creed are relegated to the background in the common determination to survive. And it must always be remembered that until the United States was forced by the treachery of Pearl Harbour to declare war on the Axis in December, 1941, we, in this country, were battling as much to prevent defeat as to gain victory.

The bitterness of Dunkirk, the sense of isolation caused by the collapse of France, the knowledge brought by air reconnaissance that Germany was preparing to invade our

island, and the determination to be revenged eventually for the horrors of the blitz—all these in the blackest months of the war were a four-rowelled spur constantly urging every section of the community to greater effort in the struggle to gain first parity, and, eventually, superiority in armaments.

Without this identity of purpose to weld into one all ranks of the civilian divisions toiling at home, it would have been impossible to have produced the weapons on the gargantuan scale demanded by the extension of the war to the four corners of the earth.

An analysis of war-time British industrial statistics shows that no armaments company of a comparable size can better the labour record of the Birmingham Small Arms Company. It enjoyed virtual freedom from strikes* throughout the years until the Allied armies, amply equipped, had surged across the Rhine to overrun Germany. In addition, culpable absenteeism and lateness were practically non-existent in the days when every gun, every shell, every bullet was desperately needed. This record is all the more praiseworthy when it is remembered that for many thousands of its workers the war did not start on September 3, 1939, but more than a year previously when

◆ *Men from all parts of the Empire took part in the war effort Here an Indian is cutting rifle barrel lengths*

* Conditions at Ruislip were so peculiar to that factory and area that, to give an unbiassed survey of the company's relationship with its workers, no account is taken of the troubles at "The Sheds" during the first three months of production there

Government orders for munitions first called for the introduction of a seven-day week at Small Heath. By the time of the collapse of Germany, therefore, these "Old Contemptibles" of the Production Front had been under the strain of conflict for more than seven years.

The immunity from labour troubles arose from a variety of causes, foremost of which was the management's practice of dealing with any grievance, imaginary or real, before it reached a stage necessitating drastic action. In these decisions there was never any pandering to a demand for the sake of obtaining temporary peace and continuance of production. That was the way to eventual chaos. The essential justice of each decision and the fact that on no occasion did the management allow its right to maintain discipline to be prejudiced earned the respect of the workers. Quickly they realized that, whether they won or lost a case, the verdict was invariably just.

So free in fact was B.S.A. from labour troubles that its happy state drew many a congratulatory comment from trade union leaders.

Where any absenteeism existed it was usually confined to particular individuals. There was only one way to deal with such people—dismissal or prosecution. But there were occasions on which managers relented. For instance, at a dispersal factory a man who had been discharged for persistent absenteeism appeared the next morning and began to work. When asked why he had returned he replied: "You do it again and my missus won't 'arf carry on at you: there wasn't 'arf a b—— row at our 'ouse last night." The very ingenuousness of the reply was enough. After a stern warning the man was re-engaged and from that moment was an example both of regularity and punctuality.

In cases where the management considered prosecution necessary, action would be taken by the Joint Production

Consultative and Advisory Committee set up in factories on the recommendation of Mr. Bevin, then Minister of Labour. The worker would be summoned to appear before a special Absentee and Lateness Sub-Committee and would be warned if his or her explanations were considered unsatisfactory. If the absenteeism or lateness continued the Sub-Committee would recommend the local National Serivce Officer to take action.

In view of the continual necessity of maintaining production, as scheduled, great care had to be exercised by managers in granting time off. Married women were always allowed two hours a week to do the family shopping and further time off when their husbands in the Forces were on leave. Similarly, mothers with young children were allowed to start work later in order that they could first get them ready for school. But these were virtually the only circumstances, other than illness, in which time off was permitted.

B.S.A. had several factories in the district known as the Black Country where the hop picking season is a traditional holiday. Year after year employees at these factories asked to be released for a week or a fortnight. In the case of full-time employees it had to be refused, but with part-time workers and women with young children the position was more difficult for the management had no power to keep them. It was no good pointing out that the guns they were making were vital. The invariable answer was, "The Army can't fight without its beer". And so for a period every year a few workers disappeared.

Some were not so open about it. At one dispersal a woman was granted her release on the grounds of overwork. Six weeks later she applied for and was given her old job, but later it was discovered that she had made £58 out in the hop fields while "recovering".

Sometimes employees would ask for their release on the ground that they wanted work of greater national importance (this despite the fact that they were making gun parts—and knew it). The real reason, of course, was that they

◆ *The assembly shop at Shirley, showing the rifles being moved to the packing department by overhead conveyor*

wanted to get other jobs in which they would be paid more money. But the managers were alive to all these dodges.

Occasionally there were workers, almost invariably temporary labourers, who considered it their right to draw a pay packet. At one dispersal there was an Indian whose job it was to sweep floors. When on the day shift he was always going to sleep. His explanation was that he could not sleep at night and so he was changed to a night shift. But the results were no better and finally the manager decided to dismiss him. The man was immediately indignant. "Me paid as labourer", he protested "You pay me *big* money and I work."

Because of the nature of the armaments it was producing, B.S.A. was, from the beginning of the war, given a priority claim on all available labour, and by 1942 the number of its workers had increased from 10,000 to 30,000. It was only natural that the quality of the unskilled labour varied considerably. As was to be expected, recruits from the Birmingham area, traditional home of light engineering, proved readily adaptable; but in other districts and towns, in which precision machine work was virtually unknown, the labour, and particularly male labour, took longer to train. In the case of the large numbers of girls who were drafted to the various B.S.A. factories from South Wales and the Tyneside areas, after the acquisition of compulsory powers by the Minister of Labour, it was not a question so much of adaptability but of ability to bear the strain of long hours. Most of them on arrival were in poor physical shape, a terrible indictment of the conditions existing in their childhood in the Special Areas. With better and regular food, however, their health rapidly improved and they became excellent operators. It was not surprising to find that many of them decided to stay after the war in the Midlands, where they could marry and raise families without the constant bogey of their husbands becoming unemployed.

At Small Heath and the other large B.S.A. factories recruits were put through a 14-day course of instruction before being drafted to production shops, but at most of the dispersal factories it was largely a case of learning while working; a recruit would sit by the side of a skilled worker for two or three days and would then be given a machine to operate (with the foreman keeping a very watchful eye to prevent an excess of "scrap").

Time and again during the war women proved that in certain work they were quicker than men. One instance of this occurred at a dispersal unit where a middle-aged woman applied for a job as a capstan operator; she was used to the work, she said, but because of family responsibilities could not start at 7-30 a.m. In a few days she took the place of a male operator, who was being called up. She started at 9-30 and, although new to the component, had completed 45 by the end of the day with only one "scrap" against the average of 60 for a full day which her predecessor had turned out with two and sometimes more "scraps". The next day, starting at the same time, she completed 60 components without any "scrap" and soon her average rose to just on 70 a day with fewer than three "scraps" a week.

It was at this particular dispersal that the manager asked the local labour exchange for millers. One such duly presented himself. When asked where he had worked previously he replied in a broad West Country accent, "Oi've had farteen years in business as my own marster". There was no doubt about his being a miller. His papers proved it. But he had applied for the job without having ever heard anything other than flour milling. However, he wanted work, was trained for a job, and was soon doing well.

It was necessary to be a psychologist to make the best possible use of the labour available. At one factory an apparently very intelligent girl applied for a post. She

Youth at War

This photograph of a girl welder together with those on the following three pages constitute four remarkable studies of Britain's youth at war They reveal the spirit of determination among the young, as well as the older, war workers to win the Battle of Production

Study in concentration — this girl is grinding a Browning gun body.

This boy, working in a toolroom, is a B S A apprentice who in the stress of war is doing a man's job On its ex-apprentices the company depends to no small extent for its future executives

When this photograph was taken this boy was only $14\frac{1}{2}$, *yet he was already machining "D" Bits in a toolroom*

had been a typist but now wanted to do more direct war work. She was put on a variety of simple jobs but at each of them made so much scrap that foremen despaired of her. In most cases such a girl would have been dismissed since machine tools were too precious to have them operated inefficiently, but in this girl the manager realized there was latent ability; something was needed to make her use the intelligence she obviously possessed. As a last resource, therefore, he put her on a machine which called for a most intricate operation—one of the most difficult in the shop. In three days the girl broke the output record for the job and in addition there had never been less "scrap".

But it was not always a case of a typist seeking work at a bench. Sometimes it was the other way about. At one dispersal a local girl who did not appear too certain of her qualifications applied for a job as a shorthand-typist. The manager, in desperate need of a secretary, gave her a test. After taking down a letter the girl crossed to her typewriter, studied her notes for a long time and finally said—"Well, either you are going to be surprised—or I am."

Within two weeks she was a first-class welder.

There were some operators who were almost too good since their earnings were so high in comparison with those of their colleagues on the same work that jealousy and discontent were engendered. One such case was that of a girl who earned between £11 and £12 a week on a machine on which the average earnings by efficient operators had previously been between £5 and £6. Her companions on other types of machines were making only £4 10s. to £5 a week and soon they were asking to be put on the "big money" machine. By mutual agreement they started taking turns at it, but none of them could earn any more on it than they were doing before. Meanwhile the displaced operator began to earn £11 to £12 a week on the machine to which

she had been transferred. Her speed on any job, in fact, was phenomenal. Because output was suffering she was switched to her original work but at the same time an appeal was made to her to accept a lower rate. To this she agreed, and in consequence her earnings were reduced to an average of £9 a week. To some it may appear that this was an unfair solution, but it was the only one by which contentment could be restored to the section. And to have dismissed a girl for being too efficient would have been Gilbertian.

It was inevitable that the dislocation of family life occasioned by the war should have brought in its train many social problems. In so far as B.S.A. was concerned, these arose chiefly in the dispersal units and "shadow" factories, in which were thrown together local labour and workers who had never before been away from home. Such problems, as they arose, were dealt with by the welfare supervisors employed in all factories, who, where necessary, sought the advice and co-operation of the manager. In this connection too an immense amount of work was done by the surgery sisters and nurses, who were often confided in by workers who did not wish to have official notice taken of their personal or domestic difficulties. There were some problems, however, which did not admit of solution and in this category came those of young girls who, through youth and lack of character, were in need of greater care and protection than it was in the management's ability to provide. Wherever possible these girls were transferred to a factory which would enable them again to live at home.

So much has been written and said of the contribution—the magnificent contribution—of women and girls to the national war effort that the part played by the men in the munition factories of the country has been largely overlooked. It must be emphazised that the men, and particularly the

fully-skilled men, were the backbone of the army of Labour. In so far as B.S.A. was concerned, men always formed the greater proportion of the workers; in fact, throughout the war the ratio was never less than two to one. No woman or girl employee was called upon to undertake night A.R.P. duty at B.S.A. factories, but the men, many of them no longer young or even middle-aged, took their regular turns at fire-watching after a long day's work. Such was their sense of duty, in fact, that throughout the whole course of the war there was only one prosecution at Small Heath for failure to fire-watch.

There were other activities which took up what little spare time was left to the workers and staff. Many of them were members of the B.S.A. Home Guard; others helped in the running of the Air Training Corps in which the company had two squadrons composed largely of its own boys and numbering in all more than 400. Other employees interested themselves in the savings campaign, and proof that the workers not only made the guns but helped to pay for them is the fact that through a special scheme operated by the company they bought in the course of the war no less than £900,000 worth of Savings Certificates.

On the subject of the health of the workers, the fact that there was no serious epidemic of illness, such as the Spanish 'flu which swept the country at the end of the Great War, proved that despite the strain of their long hours, the food rations were adequate to maintain strength. Although the surgery staff at Small Heath and at the dispersals were constantly ready to meet an epidemic in whatever form it might come, the only cases outside the normal cuts, bruises, and burns inevitable in a factory were a slight increase in the number of victims of oil dermatitis contracted as the result of operating machine tools. But even these cases, most of them mild attacks, were not out of proportion to the increase in the numbers of workers.

Finally a word of praise is due to the company's apprentices, boys of 16 upwards, who laboured throughout the war with the determination and zeal of grown men. B.S.A. has always believed in a comprehensive apprentice scheme and indeed has relied on it as one of its chief sources of executives. To-day no fewer than 20 of the factory superintendents and shop managers working under the Small Heath administration are former B.S.A. apprentices.

As the end of hostilities in Europe approached and the company began to plan for civilian production, it did not forget the men who had fought with the weapons it had helped to produce. Many months before the end of the war B.S.A. formulated its own rehabilitation scheme for ex-prisoners of war and men discharged from the services. It was open to any man, not only those who had been in the company's employ before joining up; nor was it confined to men who were whole in body but to the maimed and limbless as well.

A special school was started where the men, who were paid while learning, were taught various engineering processes. When the "schoolmaster" considered a pupil fit to go into a production shop, he was only sent there on loan. If he made good, he was left there; if he failed, he was taken back into the school where he would remain until a job more suitable to his capabilities or temperament was found for him. So highly was the scheme regarded that it was studied by officials of various Ministries and recommended to other big organizations for adoption.

CHAPTER XXVII

TRIBUTE TO SUB-CONTRACTORS

NO war history of the Birmingham Small Arms Company would be complete without a tribute to the 28 British firms which took part in the company's three major sub-contracting schemes for the production of Browning, Besa, and Oerlikon. And special tribute is due to those 28 firms engaged on the manufacture of Browning gun components, for it was they, and they alone who, by increasing their output in the grim days after the Small Heath blitz, enabled an adequate supply of guns to be maintained to the R.A.F.

The Browning sub-contracting scheme, the first of the three schemes to be instituted, was originally discussed by the company with the Air Ministry before the war as a means of augmenting output and of providing alternative sources of supply in the event of air raid damage. Its essence was that all components should be manufactured by sub-contractors and delivered for assembly to a section of the B.S.A. factory at Redditch.

Even at the start of the war it was not easy to find small engineering firms able or potentially able to produce large quantities of small precision components since a great number of them were already engaged on munition work. Altogether between 650 and 700 firms, the names of which were obtained from the telephone directories, chambers of commerce, engineering journals or on personal recommendation, were approached before the 28 were eventually chosen in places as far apart as Glasgow, Dowlais in Wales and Crawley in Sussex.

In most cases these sub-contractors had insufficient machine tools for production requirements and over a period of months just on 2,000 were supplied to them by the Ministry of Aircraft Production.

The manufacture of the components, all primary material for which was supplied by B.S.A. heat-treated and ready for machining, was supervised throughout with the greatest care with a special eye on the amount of scrap. The first six samples of a component made by a sub-contractor were submitted, first to the company's inspection department and then, if found correct, to the Government "view". Once officially accepted, instructions would be given to proceed with full scale manufacture.

Sub-contractors with their foremen, fitters and inspectors were constantly visiting Small Heath to study the company's methods, while B.S.A. engineers were on the move day and night visiting the factories of the individual firms to solve production problems and to assist in speeding output.

The first Browning made under the sub-contract scheme was delivered on July 1, 1940, the month's total being more than 600. In the first seven months of production, the most critical period in Browning gun manufacture owing to the August and November air attacks on Small Heath, just on 9,500 were delivered.

Even the combined output of Small Heath, the dispersals and the sub-contractors, however, was insufficient for R.A.F. needs. B.S.A. and Vickers Armstrongs, which also had a Browning gun contract, decided to co-operate and a pooling scheme was devised by which the B.S.A. sub-contractors concentrated on the manufacture of certain components and Vickers Armstrongs on others, principally the barrel extension and the trunnion block, which needed 78 and 59 machining operations respectively. The first deliveries under this

scheme took place in the following May and the direct result was an increase of 500 guns a month in the joint output. By the time the scheme came to an end there had been an interchange of more than 2,500,000 components.

In so far as the two Besa guns were concerned the sub-contracting scheme, important as it was, was confined to a limited number of components, contracts varying from 1,000 to 40,000 of the 43 items required.

The Oerlikon scheme, however, was comparable in scope with that of the Browning, no fewer than 43 firms in widely separated parts of the country eventually participating. It was initiated while the gun was still in its birth throes at Ruislip and was destined to produce no fewer than 16,000 of the 50,000 manufactured under B.S.A. direction during the war. The first gun produced under the scheme was fired in November, 1941, only seven months after the "Sheds", and deliveries from the four main final assembly centres in the scheme steadily rose until a combined output of more than 900 a month was achieved together with all necessary spares.

Over the whole field of small arms manufacture it was only natural that there should be a wide divergence in the production rates among manufacturers, especially among those with little or no experience of gun making. As the war progressed it became more and more obvious that the output of these manufacturers could be substantially increased were they all to receive expert advice from companies with years of experience with weapons, such as was given by B.S.A. to its sub-contractors.

To accelerate the production of these weapons most needed by the Services, Lord Beaverbrook, then Minister of Supply, brought into existence in 1941 the Automatic Gun Board under the chairmanship of Sir Peter Bennett,

M.P. for Edgbaston; the other members being Sir Charles McLaren, Director-General of Ordnance Factories; Mr. A. J. Palmer of Vickers, Mr. W. D. Kendall of the British Manufacturing and Research Company, and Mr. Leek of B.S.A. Meetings were held every month to discuss pressing problems and as a result of close co-ordination of effort there was a speedy increase in the output not only of individual firms but over the whole range of small arms manufacture.

In a conversation with me a few months ago Mr. Leek stressed one vital point about Britain's output of armaments during the war.

"No amount of organization or direction, however inspired, would alone have won the Battle of Production", he said. "We succeeded because we worked as a team from chief executives and their staffs down to the youngest apprentice.

"Nowhere was this team spirit more in evidence than in the B.S.A. organization. And if there was one period in the whole war when it was most needed, it was during the Small Heath blitz in November, 1940.

"To mention all the people, who by their tremendous efforts made it possible for us to continue production at that critical time, would be impossible, but I should like to pay formal tribute to a few of my colleagues—such as Mr. J. A. T. Dickinson, Mr. A. Brazier, Mr. W. H. Cole, Mr. P. Billson, Mr. R. J. Fearon, Mr. H. A. Faulkner, Mr. W. O. Meek, the late Mr. A. Parslow, Mr. E. Poppe, Mr. W. L. Rawson, Mr. H. J. Smith, Mr. G. C. Thomas, Mr. T. P. Whittington, Mr. S. C. Wilsdon and Mr. A. E. Wood.

"Without the spirit which infused them and their staffs, the B.S.A. war effort would have made a very different story."

EPILOGUE

A PROUD RECORD

ON four occasions in the last 130 years when Britain has risen to defend the world from dictatorship Birmingham has helped in great measure to forge the weapons of liberty.

In a rare history of the Battle of Waterloo by one Cotton, a sergeant-major, there is a phrase: "As the Duke of Wellington passed up and down the battle front he heard many murmurs of 'Let's give 'em Brummagum'" (the bayonet, most of which were then made in Birmingham). And it was the bayonet which that day brought Napoleon to his final downfall.

The march of the Kaiser's legions in 1914 was stopped only by the superb musketry of the Old Contemptibles armed with Lee-Enfields, many of which were made at Small Heath.

The Lewis gun, manufactured solely by B.S.A., contributed largely to the halting of the great German breakthrough in 1918.

In the Battle of Britain it was the Browning Gun, in the hands of the "so few" of the Royal Air Force, which saved this country from invasion and the world from Nazidom.

Lastly, by reason of the intensive research carried out in secret in the laboratories of her university throughout the war, Birmingham can justly claim to have made vital contributions to the evolution of the atomic bomb.

In this dawn of a new era, the frightening era of atomic energy, it is possible to envisage the eventual abolition of war. For what nation will allow its rulers to expose it to

certainty of partial, if not total, extinction, by atomic bombing? It appears at this point in the world's history, therefore, that never again may the so-called armament companies of this country be called upon to switch from the products of peace to the weapons of war. Whatever the future, however, the proud record of Birmingham and of the Birmingham Small Arms Company in the defence of Britain and the Empire will remain for all time an example of what free men can achieve in the hour of national peril.

FINIS